

REVIEW OF TECHNOLOGICAL ADVANCEMENTS AND OTHER MEASURES LEADING TO THE COMPLETE ERADICATION OF BRUCELLOSIS

HEARING

BEFORE THE

SUBCOMMITTEE ON LIVESTOCK, DAIRY, AND
POULTRY

OF THE

COMMITTEE ON AGRICULTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

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SEPTEMBER 23, 1989, STILLWATER, OK

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REVIEW OF TECHNOLOGICAL ADVANCEMENTS AND OTHER MEASURES LEADING TO THE COMPLETE ERADICATION OF BRUCELLOSIS

SATURDAY, SEPTEMBER 23, 1989

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON LIVESTOCK, DAIRY, AND POULTRY,
COMMITTEE ON AGRICULTURE,
Stillwater, OK.

The subcommittee met, pursuant to notice, at 9:10 a.m., in the Noble Research Center Theatre, Oklahoma State University, Hon. Charles W. Stenholm (chairman of the subcommittee) presiding.

Present: Representative Stangeland.

Also present: Representative Watkins.

Staff present: Daniel B. Waggoner and Carol Ann Dubard.

OPENING STATEMENT OF HON. CHARLES W. STENHOLM, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. STENHOLM. This public hearing will now come to order.

Today, the House Agriculture Subcommittee on Livestock, Dairy, and Poultry looks forward to receiving testimony and written statements from a very distinguished and knowledgeable slate of witnesses concerning technological advancements and other measures leading to the complete eradication of brucellosis, the past, the present, and the future.

Let me be quick to express the subcommittee's appreciation for the invitation to be here today extended by your Congressman and my good friend and colleague, Wes Watkins. As a distinguished member of the House Appropriations Committee and the subcommittee that deals with the subject that we are talking about today, Wes has continually been a strong supporter and a true friend of animal agriculture and all of agriculture. We appreciate his quality leadership in maintaining the proper Federal support for a wide variety of infectious livestock disease control programs, particularly the brucellosis program.

In addition, I am pleased that our colleague from Minnesota, Arlan Stangeland, from the Seventh District of Minnesota, could be here with us today. Arlan also represents a very large agricultural district, encompassing one of the largest dairy and livestock constituencies in the Congress.

As most who are here today know, brucellosis is a serious infectious reproductive disease in livestock which results in abortions, stillbirths, light-weight calves, and reduced milk production. The disease represents a major economic problem to the livestock indus-

try. In fact, nationwide, cattle producers incur annual production losses of more than \$15 million from brucellosis.

Since 1934, the Federal Government, working with State agencies and industry officials, has sought to control and eliminate the disease through a national brucellosis eradication program. This subcommittee applauds the constant and dedicated effort of USDA, State health officials, and producers for the cooperation and diligence which has been exhibited over the years in attempts to move closer to eradication of the disease.

Granted, the process has been a long and winding road up a very steep mountain. Nonetheless, we will hear today of the many program improvements and technological advancements that have been put into place so as to move closer in making brucellosis a disease of the past.

Certainly, the two hardest steps in any eradication program are the first and the last. The first step organizes the program boosted by enthusiasm. The last step, seeking out the last vestiges of infection, is usually impeded by complacency. To be sure, there are those who have maintained differences of opinion over the years concerning the effectiveness of the program.

However, this subcommittee commends USDA's decision in approving faster, more sensitive, and more specific automated testing procedures. As a livestock producer myself, I know from experience that it is much more productive and economical to prevent disease than to treat or depopulate a herd or flock.

Today, livestock producers can do a great deal to keep their animals free of disease. In fact, through industry, State, and Federal collaborative efforts we have eradicated over 12 major livestock diseases within the past century.

Furthermore, I know my colleagues join in my assurance that we always stand ready to assist in supporting efforts of industry, States, and USDA in developing effective approaches to this and other complex diseases.

At this point, I would like to recognize my colleagues for any opening statements or comments that they might like to make.

Wes and I have a special affinity since we both arrived in the Congress at the same time, the 96th Congress. It seems like it was just yesterday, but it was about 10 years and 9 months ago.

Wes, thank you for inviting this subcommittee to your district today.

OPENING STATEMENT OF HON. WES WATKINS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OKLAHOMA

Mr. WATKINS. Thank you, Mr. Chairman.

Let me say this. I want to welcome you, a long-time friend now, and one fellow agriculturist, along with Arlan Stangeland, a fellow farmer from the State of Minnesota. It is an honor for me to have both of you here.

Charlie, I want you to know this is Arlan's first trip to Oklahoma, and we tried to give him a little bit of the Oklahoma flavor yesterday afternoon.

Arlan, I hope that all turned out real well and you got to see part of Oklahoma.

And Charlie is a graduate of Texas Tech, and we are kind of playing them tonight. So I hope that—I know that you have to be gone. You are not going to be able to stay around for the game.

Mr. STENHOLM. But my heart is going to be here.

Mr. WATKINS. And I hope I can brag Monday when I see you.
[Laughter.]

But I am delighted and appreciative of both of you to take time, and I would like to say to all the people in the audience that all of us have plenty of things to do in our own districts. But when two colleagues, one from Minnesota and one from Texas, take time to come and not go home to their own areas to tend a lot of concerns I know that is there, they are literally committed to try to help solve problems across this Nation, and I appreciate them being here.

I will say up front that today we are here to talk about brucellosis eradication. An eradication program must be carried out in this State and this Nation. We are not here to talk about a brucellosis control program. I believe the testimony we will hear today will point to how close we are in this Nation to eradication of brucellosis. Randell, you and Kenny and Doc, John, we have been working on this for a long time.

We are on track with a control program until 1954, when we began to look toward eradication. We spent \$1.5 billion trying to rid cattlemen of this costly disease. I believe in testimony today we will hear about the substantial progress which has been made.

As a former cattleman myself, whose cattle herd had brucellosis, we banded them out. And I went out of business and came to college here, Jimmy, with \$88 in my pocket after I paid off the notes. And part of that reason was the drought of 1956. The cattle herd had banded out. You can see I have more than a passing interest in brucellosis.

But I want to see it on the House Appropriations Committee and the Subcommittee on Rural Development, Agriculture, and Related Agencies. Not only was this a personal situation that I had experienced, but it was the personal experience of thousands of cattlemen across the country.

In 1983, I convened the National Conference on Innovative Approaches to the Eradication of Brucellosis. I knew that we had to do something different, Charlie and Arlan, than what we had been doing. The program that was adopted was to run until 1990. Now is the time to review, especially since the number of infectious herds appear to have been reduced to less than 2,000 herds out of a total herd population of 1,440,189.

In 1983, we found that well over \$1 billion had been spent on control programs. But very little resources had been diverted to research for some solution. In fact, only about \$14 million had been invested in trying to find a solution.

The national conference consisting of three different meetings came to several consensus which we will be talking about more today. On the House Appropriations Subcommittee on Rural Development and Agriculture, which we have tried to do our part in redirecting funds into high priority areas. For fiscal year 1990, the House added an additional \$6 million while the Senate added approximately \$7 million for increased effort to rid ourself of this disease.

The conference committee in the next few weeks, in fact, I have to fly out tomorrow night to go back to Washington, because the conference committee between the Senate and the House has been called for about 1 p.m. Monday afternoon. I am sure we will find an answer to providing the dollars to work on this program.

We are hearing and knowing more about a new plan that may offer a shortcut and time and money to achieving our goal of brucellosis eradication. I am sure much of the topic of discussion today will focus on the rapid completion plan.

I will not prolong my statement this morning. I will close by saying that I believe we are on a threshold of seeing the Nation's cattlemen greatly relieved of economic burden that has straddled them for quite some time. I hope so anyway.

I have talked to a lot of researchers in a lot of different areas. It will not only be a savings to cattlemen, but to the taxpayer. We no longer will need to spend \$66 million a year to rid ourselves of this disease, and that is what we are paying out.

I look forward to hearing all of your comments today on the progress that has been made. If the goals of the 1983 plan have been met and followed, and where do we go from here, I think we will be finding a solution.

Mr. Chairman, I am not only honored that you and Congressman Stangeland for being here, but I am excited about the testimony that we will be hearing and about the possibility, because I would like to see a solution to this thing somewhere along the way.

Thank you.

Mr. STENHOLM. Thank you, Wes.

Arlan, we welcome your opening statement.

OPENING STATEMENT OF HON. ARLAN STANGELAND, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MINNESOTA

Mr. STANGELAND. Thank you, Charlie. I will try and be very brief.

I just want to commend you for bringing the subcommittee here to Stillwater and the Oklahoma State University, one of the most respected land-grant colleges I think in the land-grant system. Also, I am pleased to be here in the district of Wes Watkins.

Wes, thank you for yesterday, and the assistance of your staff. I enjoyed it very much. This is my first trip to Oklahoma and I am a farmer. I like to get out and see how other people work and operate in other parts of the country. And it was very interesting. We went to the Cowboy Hall of Fame, a great history of Oklahoma, but also a great history of this country as well. And that was interesting. The time is too short actually, but we will be back.

I want to tell you, Charlie, we like to work with Wes on agricultural matters, but I am also the senior Republican on water resources. And you and I, Charlie, we authorize, but Wes sits over there in appropriations and he handles the purse strings. He appropriates. So it is good to cultivate that friendship.

I am pleased to be here and I look forward to what appears to be a very outstanding series of panels of very technical experts on the very serious problem of brucellosis and its eradication.

I have been a livestock man all my life as well, and know the importance of what you are trying to do.

Thank you.

Mr. STENHOLM. Before we call our first scheduled witness, I would like to make some announcements. To any of you who are witnesses who have arrived late, we would appreciate it if you would bring copies of your statements down to the front so that we might have them at the appropriate time.

Also, I would like to announce that today's hearing record will remain open for 10 days to receive all requested and submitted material.

Furthermore, the Chair would respectfully ask that each witness try as best you can to summarize your oral remarks within a 5-minute time allowance with the assurance that all written testimony will be made a part of today's printed hearing record.

Hopefully, if time will permit, we will have some additional time at the end of this hearing to allow anyone who would like to express themselves on the subject of this hearing.

If there are no additional opening remarks, let us proceed now with our first witnesses. I would like to ask Dr. Billy Johnson and Dr. Norman Cheville to take your seats at the witness table.

STATEMENT OF BILLY G. JOHNSON, ASSOCIATE DEPUTY ADMINISTRATOR, VETERINARY SERVICES, ANIMAL AND PLANT HEALTH INSPECTION SERVICE, U.S. DEPARTMENT OF AGRICULTURE, ACCOMPANIED BY NORMAN CHEVILLE, RESEARCH LEADER, BRUCELLOSIS RESEARCH UNIT, NATIONAL ANIMAL DISEASE CENTER, AGRICULTURAL RESEARCH SERVICE

Mr. JOHNSON. Mr. Chairman, members of the committee, we are pleased to be here today to discuss the status and the history of the brucellosis eradication program as well as options for the future direction of the program.

With me today is Dr. Norman Cheville, Research Leader, Pathology and Research Unit, National Animal Disease Center, from Ames, Iowa.

ARS has provided important research to help support the brucellosis eradication program. Current research encompasses both biotechnology and classical approaches to develop improved diagnostic methods and an approved vaccine. They will also define the mechanisms by which the immune system of cattle either resists the infection or allows it to develop.

The brucellosis eradication program has been a long and difficult task, but we have learned much and made significant progress in the eradication of this reproductive disease that can be so harmful to livestock, to public health, and to interstate and international commerce.

In 1934, as was mentioned, the State/Federal cooperative program was launched on a national scale. At that time it was part of a drought relief program. But the goal was to reduce the number of cattle by eliminating diseased animals. The rate of reactors in the tested population of adult animals at that time was about 11.5 percent.

By 1937, the reactor rate among tested cattle had decreased to about 5 percent. Between 1939 and 1942, significant progress was made, but much of that progress was slowed down during the war years as efforts were turned to the war effort.

Programs such as brucellosis naturally took the back seat. The infection rate, the reactor rate, reached 5 percent again in 1946, after having reached a low of 2.6 percent in 1941.

In 1947, the U.S. Livestock Sanitary Association—USLSA—which later became the U.S. Animal Health Association—USAHA—recommended the adoption of the first Uniform Methods and Rules—UM&R—for the eradication of brucellosis on a herd basis. The UM&R, for the first time, approached brucellosis as a national problem. It remains the foundation of the eradication program and provides a flexible mechanism to modify the program to meet changing needs and incorporate new technologies.

The 1950's saw the acceleration of the program and improvements in available technology, including the adoption of the milk ring test to allow frequent screening of dairy herds at a low cost and the development of an acidified plate antigen test for differentiating nonspecific reactions.

Also the market cattle testing program, in which cattle are tested at slaughter and concentration points, was adopted in 1959, allowing the program to move away from an area testing effort and toward tracing infection to individual herds.

In 1960, the USLSA established national goals for the program. The goals were to have all States achieve modified certified status by 1965; all States were to be certified free of brucellosis by 1972; and all States were to be free of swine brucellosis by 1979. Unfortunately, although progress continued, achieving these goals proved difficult. Part of the reason was the decision to deemphasize vaccination starting in 1967.

Improvements in testing continued in 1963, when the brucellosis card test was adopted as an official test for swine, although the effort against swine brucellosis did not become a national program until 1972. In 1966, the brucellosis card test was adopted for both cattle and swine.

The goal for eradication was set back somewhat in the 1970's as a series of disease emergencies, including hog cholera and exotic Newcastle disease, resulted in a redirection of resources to meet those emergencies. To strengthen the program during this period, the UM&R was again revised. Strengthening measures included testing at the first point of concentration and "S" branding of exposed animals to prevent diversion to markets other than slaughter, and these were begun in high incident States.

In addition, more emphasis was placed on research and calfhood vaccination. Once the other disease emergencies were under control, Congress increased funding for the brucellosis program. The additional funds allowed for the expansion of herd depopulation, contact herd testing, and selected area testing.

In 1976, adult vaccination was again added to the UM&R as an approved procedure for infected herds. This became possible because reduced dosages were used along with supplemental tests to differentiate infection from vaccine responses. Five years later, re-

duced-dose calfhood vaccination was also implemented as part of the program.

The Department appointed a Brucellosis Technical Commission in 1976 to review and evaluate the eradication program. The Commission issued its final report in 1976, indicating that eradication was feasible through a cooperative program. The Commission also made some specific recommendations, and these led to a major revision of the Uniform Methods and Rules that became effective in May 1982. The revision changed both the classification system and the requirement for movement within and between areas.

Under the new classification system, there are four classes of States: Class free, with no infection over the previous 12 months; class A, with less than 0.25 percent over the previous 12 months; class B, with less than 1.5 percent herd infection rate over the 12 months; and class C would be those States with more than 1.5 percent.

We have made tremendous progress since 1982 with those efforts and those changes. We have seen a 60-percent increase in the number of free States, and we no longer have any States or areas that are class C. In fact, the last class C area in the country—which was southern Florida—was elevated to class B only 8 months ago. Only 6 class B States and 17 class A States remain. The U.S. Virgin Islands are class free and Puerto Rico is class A. Currently, the overall incidence of brucellosis in the United States is 0.22 percent, less than one-fourth of 1 percent.

One landmark in achieving the tools that we needed for brucellosis eradication was the 1983 conference on innovative approaches to brucellosis prevention. This conference, sponsored by Congressman Watkins, helped focus our efforts toward filling certain technological gaps. We are pleased with the progress of the cooperative effort, and we continue to look for ways to improve the program.

For example, we recently completed the phase-out of the brucellosis information system, a recordkeeping system that was instituted in 1981. This system is being replaced by a microcomputer-based recordkeeping system that we expect to be fully in place by the end of fiscal year 1990.

We have also recently added more sophisticated testing techniques to the program, including the Automated Particle Concentration Fluorescence Immunoassay Test known as PCFIA. The PCFIA test is a highly automated procedure that allows us to reduce human error and gives highly reproducible results. In addition, the test is more specific than the card test, eliminating many false positives.

In 1985, we established a plan to diminish the Federal role in the program over a 5-year period beginning in fiscal year 1986. Our goal was to let the States take on increased responsibility for eradication while the Federal role moved toward enforcement of interstate movement regulations, disease surveillance, and recordkeeping.

Recently, however, the National Cattlemen's Association asked APHIS to develop a plan for the rapid completion of brucellosis eradication.

The four options addressed in the plan are to:

One, continue on our present course of diminishing the Federal role;

Two, continue at the current level until all States are qualified for class free status;

Three, accelerate operations somewhat until all States qualify for class free status; and

Four, adopt an accelerated program that would achieve eradication in 5 years.

We are currently evaluating what direction the program will take in the development of the fiscal year 1991 budget. However, we intend to move forward as rapidly as possible, within available resources, with our cooperators in the States and industry to ensure that we progress toward elimination of this serious disease.

This concludes my prepared remarks, Mr. Chairman. We would be glad to respond to any questions that you may have.

[The prepared statements of Mr. Johnson and Mr. Cheville appear at the conclusion of the hearing.]

Mr. STENHOLM. Thank you, Dr. Johnson.

For the record, you are the Associate Deputy Administrator for Veterinary Services, APHIS, U.S. Department of Agriculture, Washington, DC, and you are joined by Dr. Norman Cheville, Research Leader, Brucellosis Research Unit, National Animal Disease Center, U.S. Department of Agriculture, Ames, Iowa, and I understand that you do not have a statement. But you are here to respond to questions, is that correct?

Mr. CHEVILLE. That is correct.

Mr. STENHOLM. Mr. Watkins.

Mr. WATKINS. Let me say that I am glad to hear that progress is being made along that line. Similarly, we had in 1983, trying to find more of a solution with research activities continuing.

I was just trying to do a quick calculation here. We have about 2,000 herds out of the total population of 1,440,000 roughly that are affected.

Are you talking about just females in the herd, or are you talking about the entire population of a herd?

Mr. JOHNSON. We're talking about the entire population of a herd. The quarantines are placed on a herd. It includes all animals, and it concludes those for movement purposes except for steers and spayed heifers.

Mr. WATKINS. Out of the 2,000 herd, do you know roughly how many head we are talking about?

Mr. JOHNSON. Normally we average about 50 head of animals per infected herd. We do have some larger herds in certain areas of the country, however, such as in an area in California where we have the large dairy herds. Some of the herds in Florida and Texas are larger, but we normally average about 50 animals per herd.

Mr. WATKINS. So we are talking probably 100,000 head or so?

Mr. JOHNSON. In that neighborhood.

Mr. WATKINS. It is getting down. Talk about how rapid, I think maybe we want to look at the accelerated program. Just looking at figures we may find ourself in a shape that we can try to get these all cleared up pretty fast, more rapid than what we had in the past.

Would you like to comment a little bit more about the rapid acceleration program for our conception as well as the audience?

Mr. JOHNSON. Thank you.

We were requested last year to prepare a plan for rapid completion. This was requested by the National Cattlemen's Association. This plan is designed to have all States free within 5 years. It will concentrate heavily on the use of herd depopulation, particularly in the smaller herds, and on the use of whole-herd vaccination in the larger herds. There would be increased emphasis on epidemiology, and continued strong support for calf vaccination.

So it is designed to try to eliminate as many of the smaller herds as possible through depopulation, and put major emphasis on epidemiology and whole-herd vaccination in the large herd with the use of depopulation later in the larger herds as we see those that are continuing to stay infected.

Mr. WATKINS. Have you looked at the price tag on that, what would be the cost to—

Mr. JOHNSON. The estimated cost last year, as this plan was prepared, was for full depopulation as needed. It was anticipated that the price tag would be about \$88 million if we had started in 1989, going up to \$91 million for next year, then beginning to drop to \$85, and then very rapidly dropping the fourth and fifth years to \$50 and \$40 million.

So what it does is move the figures and the cost from later years to the first 3 years, making a major effort to eliminate as many infected herds as possible very quickly, to bring those States into a chance for free status within a 4- to 5-year period.

Mr. WATKINS. One last question. I know my colleagues have some questions. Are you considering this depopulation of herds on a voluntary basis to try to offer a carrot instead of a stick to get these working?

Mr. JOHNSON. Herd depopulation would be voluntary. The plan calls for all herds to be either depopulated or under a whole-herd vaccination program. So it would be voluntary for depopulation.

Mr. WATKINS. That would be the policy that—

Mr. JOHNSON. Yes, sir.

Mr. WATKINS. It's interesting.

Mr. Chairman, I yield the rest of my time.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. Thank you, Mr. Chairman. Just a couple brief questions.

Of the 2,000 herds, roughly 2,000 herds that are still infected, those are primarily beef herds in range conditions. You are not going to find many dairy herds still infected, are you?

Mr. JOHNSON. Most of those herds are beef herds. We do still have some infection in a fairly small number, mostly rather large dairy herds. We have a section in southern California with about 20 dairy herds infected that are very large herds. Most of the infection is in beef herds.

Mr. STANGELAND. You have developed a vaccine that you can vaccinate an adult female animal and you can determine that titers in later years, the titer is from the actual disease or from the vaccine, or what happens when you vaccinate an adult animal. Is that adult animal to be terminated at some point to the market?

Mr. JOHNSON. In the 1950's, we used adult vaccination with the full dose of vaccine, and the program was stopped because it was too difficult to detect which was vaccination and which was infection.

In the 1970's, we went to what we call reduced dose of the vaccine. This is a vaccine with a much lower number of organisms. It was found that we could use that in adults and go back to a testing program within 3 or 4 months. This was done based upon newer tests such as the Rivanol, the complement fixation test, and the PCFIA that we are now using. So we can go back into the herds after a fairly short period. We can develop a base line, can detect the animals that are infected.

These animals then, as they become negative on those tests, are free animals. If they remain free of the disease they can enter again into the population and can be sold for breeding purposes if the herd is cleaned up and released from quarantine.

Mr. STANGELAND. Just one last question. If the accelerated program to achieve eradication in 5 years is adopted, are you reasonably certain that we're talking 5 years, or is it reasonable to assume that we can do this in 5 years?

Another thing; what's the chance or possibility of reinfection from a deer herd population, a wild population?

Mr. JOHNSON. In developing the plan and basing it upon the progress that's been made in other parts of the country, we do feel that it's a reasonable plan and expect that goal to be met.

In work that has been done so far, deer do not appear to be a significant carrier of the disease. Once you remove the infection from the cattle, the deer population will free itself of brucellosis.

The only wild animals in the cattle population that appears to still be a problem and will be as we move on are bison and elk. Those animals can become infected and we will have to deal with it. However, we do have the cattle population primarily free of the disease around the area where the elk and bison are known to be infected in the Yellowstone National Park area.

Mr. STANGELAND. Thank you.

Thank you, Mr. Chairman.

Mr. STENHOLM. What about wild hogs?

Mr. JOHNSON. Wild hogs remain a problem. They can become infected with brucellosis. They can and will be a problem that we will have to deal with in the swine brucellosis eradication program. They are not a significant problem as it relates to cattle.

I might ask Dr. Cheville if he would like to comment further on that.

Mr. CHEVILLE. On brucellosis in swine? No, I would agree with you.

Mr. STENHOLM. On January 4, 1989, USDA announced that it was amending the brucellosis regulations to restrict the interstate movement of female cattle from areas with a high incidence of the disease to protect areas where brucellosis has been eradicated.

Can you comment on what noticeable results have already occurred regarding this regulation?

Mr. JOHNSON. I think it's too early to see any significant changes on that. I think we might say that our 1982 changes that imposed additional testing requirements were based on recommendations

from the technical commission that indicated that brucellosis does move heavily with the movement of animals.

We added on significant restrictions as well as lengthened the quarantine period for infected herds to make sure animals did not move from those. I think the movement of animals is one of the key factors in controlling brucellosis.

Mr. WATKINS. A question relating to that, Charlie.

What level of infection can you not move them out of State? I have been hearing a little bit about this. Is it a class B State or is it a State that is not free, not a class A?

Mr. JOHNSON. The changes that went in applied—

Mr. WATKINS. I am being very mild when I said I am hearing about it.

Mr. JOHNSON. We have heard plenty, too.

The changes that went in primarily referred to the control on movement out of class C States. The uniform methods and rules were amended to state—this was several years ago—that after October 1988, breeding animals would not be able to move out of class C States. There is a target date in 1990 to move that forward for class B States.

We did put that into the regulations in 1988 and it had significant restrictions on class C States. However, we have been fortunate that all of our high incident States have progressed beyond the class C status.

However, that amendment does place restrictions on heifers out of infected herds. Before, they had been allowed to move if they were under a certain age. And so there is a restriction on heifers out of infected herds that was not in prior to that time.

Mr. WATKINS. Only infected herds?

Mr. JOHNSON. Only infected herds.

At the present time the interstate movement requirements—from the Federal standpoint—allow movement of animals from class free States provided they are moved on the basis of a health certificate.

From class A States, the animals are required to be tested prior to the movement. There is a recommendation that they be retested after movement, but it is not mandatory.

From class B States, breeding-age animals must be tested prior to movement, and then quarantined and retested at destination 45 to 120 days after they arrive.

Under the restrictions that were on class C States prior to these last amendments, animals could move if they had been tested two times at a 60-day interval prior to movement, and then quarantined and retested after movement.

Again, we do not have class C areas, so that no longer affects us.

Mr. STENHOLM. In your opinion, is depopulation a viable, workable part of the overall program to eradicate brucellosis?

Mr. JOHNSON. In 1977 and 1978, when we again placed significant emphasis on brucellosis, we initiated accelerated programs in the Southeastern States, Georgia, Tennessee, Alabama, and a number of others. We put herd depopulation in as a vital part of that program.

As we completed the program in those States, the reaction they had to us was that herd depopulation was a very viable part in reducing the infection, particularly in the smaller herds.

Brucellosis not only moves as animals are moved from one herd to the other, but it will also spread across the fence to other herds.

When you have herds that are infected where the owner is willing to depopulate, you remove that source of infection from the community, and prevent that spread to additional herds. We know, based on the history in all of our States, that if you leave infected herds and go through the testing program, you can expect in the neighborhood of 20 percent of the adjacent herds to eventually become infected. Depopulation removes that source from the community, and we feel it is a very important part of the program.

The State officials and the industry officials have all told us that it's a very critical and very important part of the program.

Mr. STENHOLM. What is it about the deer species that would allow them to eradicate the disease themselves when it's not possible in cattle?

Mr. JOHNSON. Dr. Cheville.

Mr. STENHOLM. Did you make that statement?

Mr. JOHNSON. Yes.

Mr. STENHOLM. Did you make an error?

Mr. JOHNSON. No.

Mr. CHEVILLE. Well, it is a natural immunity. A difference between species. They are just not easily infected as cattle are. So there is not the problem of individual-to-individual transmission.

Mr. JOHNSON. I think one thing is we do not see the abortions in the deer that we do in the other species. Cattle, swine, bison will abort when they have the disease in many instances. Abortions creates a very high source for spread. You have millions and millions of organisms that are spread with the abortion. Other animals, particularly cattle that lick the young, will then pick up the disease and it spreads rapidly. If you do get it in a deer, it is self-limiting in those particular animals that pick it up from the cattle and then does not continue to spread within their population as we see in the other animals.

Mr. STENHOLM. Would you comment concerning some of USDA's ongoing research related to brucellosis?

Mr. CHEVILLE. Our research program has focused in four areas.

First, we want to break down the bacterium into its component parts and find a component that we can use in the vaccine or a test. That is a major thrust of the program. It has widespread implications to everything.

Second is genetic engineering. We want to use recombinant DNA technology to produce what is called a deletion mutant, or bacterial strain, a bacterial strain that lacks a particular virulence factor that we can use in a vaccine. And we have made some progress there. We're encouraged.

Third, we have a small program to refine our testing program in cattle to provide a better testing protocol so that this test procedure for new vaccine, will reflect reality in the field.

And last, we have an even smaller portion of our budget on understanding the disease process itself. Looking at why the female reproductive tract is so important in this disease.

We are some ways away from an improved vaccine over Strain 19, but it is conceivable within a 3-year period we could have a vaccine that could be used in the field.

Mr. WATKINS. Will you elaborate on that? That is one of the things we have asked to be focused on over the 1983 conference, because Strain 19 is a live vaccine, and we know it has not been working to a certain extent, but it has some tremendous limitations we asked for. Look at synthetic vaccine and the kill vaccine both—

Mr. CHEVILLE. I think we could produce that, but it is a two-edged sword. When you get into dead bacteria, the cow does not respond to that. And my own opinion is that we are stuck with a live organism. It is a way the cow is going to respond to this kind of disease.

That may not be true, and we are certainly proceeding along the lines that we can purify a bacterial component that will be effective as a vaccine. But I think when we get into the field work, the nature of brucellosis, like tuberculosis, will require that we have a live vaccine.

Mr. WATKINS. It is different than hog cholera—

Mr. CHEVILLE. Oh, completely, yes.

Mr. WATKINS. That has the synthetic vaccine.

Mr. CHEVILLE. Certainly.

Mr. WATKINS. Thank you.

Mr. STENHOLM. Several States have developed certified free herd programs. Is there any data that you are aware of now that clearly indicates the effectiveness of these programs in controlling the disease?

Mr. JOHNSON. Certified free-herd status has been a very important part of the program, particularly in the high incidence States. This is a program where herds must have two negative tests 12 months apart.

The advantages of having a certified herd is for movement purposes. This permitted herd owners that were in high incident States to certify their herds and have rather free movement of cattle from those herds. Particularly if they were important breeding animals, it was very critical.

As States become low-incidence and then become free, there is less need to have certified herds, because from a free State they have free movement anyhow. So it is a method for herd owners in high-incidence areas to have increased ability to move their animals.

It has been a very important part in some high incidence States. We have a lot of certified herds in States like Florida and Texas for that reason.

I think it is important as long as the State has high incidence of the disease. This is a vital part and many of the herd owners will want to participate in it.

Mr. STENHOLM. Wes.

Mr. WATKINS. Doctor, I cannot let you off that easy. I want to pursue that question on why the live vaccine continues and the kill or synthetic—

Mr. CHEVILLE. What I said is we will try to perfect a synthetic vaccine. We have not abandoned that idea. But my intuitive feeling

about the disease is that it is going to require a live deletion mutant to produce effective——

Mr. WATKINS. Why?

Mr. CHEVILLE. Well, because the organism resides inside cells, and it is protected from a lot of immune mechanisms of the cow. And from what I know about that kind of bacterial infection is that the live vaccine is always superior. It helps to sustain a long period of immune reactivity in the cow, and gets at the overriding problem of persistent infections.

A cow is infected. It becomes chronic and the bacteria hides out in certain tissues. And for the cow to combat that, it requires this persistent stimulus in the live organism.

I may be wrong on that, but that is just my long-term feeling.

Mr. WATKINS. Yes, you are indicating that the cows do not utilize the kill or synthetic vaccine and penetrate in there like a live one.

Mr. CHEVILLE. That is correct.

Mr. WATKINS. I cannot imagine all the other diseases of this world if we could not find some that could work that way.

Mr. CHEVILLE. Well, we can for a lot of bacterial disease. Certainly most of the bacterial toxins are very effective. But for this class of bacteria that are called intracellular infection, tuberculosis, salmonellosis, it is very difficult to get the kind of immunity to prevent that chronic persistent infection.

Certainly we can prevent an acute thing, but we are after this long term, chronic.

Mr. WATKINS. Mr. Chairman, I do not want to take all the time on this, but I will get maybe a little time to talk personally with you to pursue this, because I am deeply disturbed with a little bit of this type thinking, to be very honest with you. I want to follow up on it because I think it disturbs a lot of people.

Mr. CHEVILLE. Yes. As I said first, our first major part of our program is to produce a synthetic vaccine, so we are proceeding on those lines. But when I tell you my intuitive feeling is that it may not work with such effectivity that we can eliminate brucellosis from animals such as bison. I am just not certain.

Mr. WATKINS. I will pursue that.

Mr. STENHOLM. What is the individual producer's responsibility in developing an effective brucellosis eradication program?

Mr. JOHNSON. I guess, in answer to that, I would have to state that our program for brucellosis eradication is a cooperative program, and it has to be an equal three-way cooperation between the Federal, as we provide funds and personnel; the State that provides the legal authority, the mechanism within each State; and then the livestock industry as the third and the critical part of it.

I think the major part then that the livestock industry must do, as we have in any program, is be in support of the program and in agreement that the disease can be controlled and then eradicated. They must cooperate in the program. And I think here there are three things: One, is cooperating as far as trying to do the things that are necessary to prevent infection from coming into their herds—look carefully at the animals that they bring into their herds to be sure that they have been tested or come from free herds. Second, they should maintain, if it's in an area where it's critical, careful vaccination. Third, they should be careful with

movements of animals out of their herd if they suspect a disease happens to be there; that they cooperate in reporting if they are having abortions and then to cooperate with the program if they do become infected. They must present their herd for testing, try to work out the very best possible herd plan with the local officials in testing and eliminating the disease from their herd. I think cooperation is the critical point.

Mr. STENHOLM. We thank both of you very much for your testimony today. Thanks very much.

Mr. JOHNSON. Thanks.

Mr. STENHOLM. Our next panel is, Dr. Hartin, Dr. Holcombe, and Dr. Woods.

Mr. WATKINS. Mr. Chairman, while this panel is coming forward, I would like to make an introduction.

Mr. STENHOLM. You are recognized.

Mr. WATKINS. I do not think he is on the program, so I would like to introduce the dean of the college of agriculture of Oklahoma State University, Dr. Charles Browning. I would like for him to stand. I know Dr. Alexander is going to be on the program in a little while.

And also let me say one of the fine veterinarians who is on the board of regents of Oklahoma State University, who is a doctor for a few of my wife's pets, and she believes in the guy, Dr. John Montgomery.

Mr. STENHOLM. First witness, Dr. Robert Hartin, State veterinarian, animal industry division, Oklahoma Department of Agriculture.

**STATEMENT OF ROBERT L. HARTIN, STATE VETERINARIAN AND
DIRECTOR, ANIMAL INDUSTRY DIVISION, OKLAHOMA DEPARTMENT OF AGRICULTURE**

Mr. HARTIN. Mr. Chairman, members of the committee. It is a pleasure to be able to report to this committee today on brucellosis.

The brucellosis eradication program has been going on too long. The knowledge and technology are available to complete the job, and it must be done.

Considerable progress has been made in Oklahoma. Ten years ago we had approximately 600 known affected herds. Today we have 138. This is a reduction of 77 percent. Ten years ago we had over 15,000 known infected animals or reactors per year. Last year that number was less than 4,000, a reduction of 75 percent. This is progress, but it is too slow.

A number of program improvements have been made over the years such as mandatory vaccination, adult vaccination, first point testing, adjacent herd testing out to one-half mile, improved epidemiologies, and the addition of the PCFIA test. All of these have been effective in reducing the number of infected herds and the spread within these herds. It is again time to reevaluate and fine-tune our program to finish the job at hand.

Our vaccination program, implemented in 1982, has been highly successful in getting large numbers of heifers vaccinated. We were vaccinating about 200,000 heifers per year prior to 1982, and it is

now over 750,000 heifers per year, but this has also created additional problems.

Since January 1 of this year, we have had almost 1,400 MCI, or market-reactor animals, tracebacks if you will. Only 8 percent of these have led us to an infected herd. Most of the remainder of these were due to residual vaccination titers.

Considerable funds and resources have been spent in the last few years to develop a vaccine and/or test to differentiate between vaccine titer and field strain infection. It is not available today. If such a vaccine were perfected, it would be 3 to 5 years before its impact would be felt in the eradication program, and by then we must be brucellosis free in all States.

Other countries could benefit if a better vaccine was perfected, but it would have little or no effect on the final eradication in the United States. It is my opinion that those resources currently expended in vaccination research could be better used and should be directed into another area that would have a more positive impact on final eradication.

APHIS developed a 5-year plan to be out of major portions of the eradication program by October 1990, with each State assuming the major responsibilities to finish the job. Now is not the time to back off. All resources that are needed to finish the job must be made available until the last infected animal is eliminated. This is not an individual State problem. It is a national problem. Some 44 States are now declared brucellosis free or class A. These States spent millions of dollars of both State and Federal money to get there, but they will not remain free very long if complete eradication is not achieved.

Oklahoma imports approximately 1.5 million cattle each year, and we export almost 3 million cattle. This movement is an essential part in the production of the beef industry nationally. Our imports come primarily from the Southeastern States where brucellosis is more prevalent and our exports move mostly to the North and Northwest to the lower incident States.

We should not expect to obtain and maintain free status in Oklahoma until those States shipping us their cattle have eliminated all foci of infection.

Likewise, those States receiving our cattle will be at risk of becoming reinfected until final eradication is completed.

Complete eradication is possible. The tools and technology are available. We must use them.

Recently, at the request of the National Cattlemen's Association, USDA formulated a proposal known as the rapid completion plan. This plan has two major elements: depopulation and/or whole-herd vaccination.

Recently, Governor Bellman appointed a brucellosis advisory committee in Oklahoma representing all segments of the livestock industry. This committee is looking at every possible way to accelerate the eradication of brucellosis in Oklahoma, including the two main elements in the rapid completion plan: Mandatory depopulation and/or whole-herd vaccination.

Complete eradication is not only possible but it is essential that it be completed. The knowledge, skills, and technologies are available, but it cannot be done by each State supplying their own re-

sources. It must continue to be a cooperative effort of all States and the Federal Government. The rapid completion plan has these elements, but the resources need to be made available to carry the plan out.

I urge you to give serious consideration to supplying the funds to complete the job. The American cattlemen cannot afford to lose what has taken so long to achieve. We are close. let's finish the job.

That completes my report. I will be glad to answer any questions you may have.

[The prepared statement of Mr. Hartin appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Dr. John Holcombe, director, Texas Animal Health Commission, Austin Texas. Thank you for being hear today.

STATEMENT OF JOHN W. HOLCOMBE, EXECUTIVE DIRECTOR, TEXAS ANIMAL HEALTH COMMISSION

Mr. HOLCOMBE. I am pleased to be here to submit testimony concerning the brucellosis eradication program. There is light at the end of the tunnel. We see brucellosis eradication through the rapid completion plan.

Mr. Chairman, you will have to forgive my voice. It is weakening of the vocal cords, I think, and it gets very disturbing to me and others that I have to talk to.

Nationally, brucellosis eradication has gained momentum and impressive progress is being made. In 1982, for example, only 13 States were considered to be free of brucellosis. Today, 28 States are rid of the disease and another 18 have very little infection. In six States, including Texas, concerted eradication efforts are underway to clean up higher rates of infection. And this is where efforts must have continued focus.

In Texas, more headway has been made in the last 10 years than all the other decades combined. In fiscal year 1989, 1,113 herds in the State were infected. A dramatic improvement over 1982, when 3,241 herds were quarantined. Today in Texas, 715 herds are currently under quarantine, the lowest number since the brucellosis program started. Stepped up herd testing and technical improvements in Texas State Federal laboratories factor into the program's success. Increased herd testing has resulted in infection being found more often on the ranch before cattle are moved into commerce.

In fiscal year 1989, we found 3,000 fewer infected cattle through livestock market testing than in 1988. This is a 64-percent decrease in 1 year. The drop in infected herds, combined with detecting a higher percentage of infection on site, are indicators that we are closing in on the last vestiges of this disease.

In Texas, the State Federal laboratories' high technology and equipment is used to test 3.5 million samples submitted each year. Particularly valuable is the federally funded PCFIA computerized equipment that provides more accurate test results and is less subject to human error. Use of PCFIA equipment has cut in half the number of samples traditionally considered to be untestable because of deterioration.

The continued success of the brucellosis program on a national and State level depends on three major components. These three components are as important to the program as the three legs on an old-fashioned milking stool. Anyone who has sat on such a stool knows that for proper support each stool leg must be the same length and strength.

In this analogy, one stool leg represents the Federal and State governments. Agencies are mandated to conduct testing, quarantine infected herds, and work with producers to meet standards to provide technical assistance.

The second stool leg is the cattle industry which must undertake equal responsibility for cleaning up and preventing brucellosis. Texas producers during the past 10 years have become more cooperative and positive about the program. Many are instituting management practices to prevent infection such as having heifers calf-hood vaccinated, keeping purchased heifers separate from the main herds until they have been retested for brucellosis, and having herds certified brucellosis free.

The stool's third leg would be the funding for the rapid completion plan. Without a third leg, the stool loses balance and tips over. Without this funding, the brucellosis program loses balance and regulatory staff and producers would be unable to accomplish eradication objectives in a timely manner.

Funding and a 5-year commitment by all parties involved would maintain momentum and bring to a close the national brucellosis eradication program. We are close to finding the last sources of infection. To slow the program now would result in the disease being reintroduced in clean areas. Where brucellosis still exists, it would take a stronger hold.

With rapid completion plan funding, the regulatory agencies could offer producers a choice, have the adult cattle in the infected herds vaccinated or depopulate the herd, a move that would accelerate the eradication program. Depopulation funds have never been used in Texas, but they could be beneficial, especially in small herds or when owners do not want to go through the frequent testing process or when they refuse to have adult cattle vaccinated.

The approval of the rapid completion plan would support needed technical reviews. In depth epidemiological studies would be conducted in counties or sections of counties where high incidence of infection exists that has not responded to usual eradication measures.

Historically, our country has proven its ability and dedication to the eradication of the disease. We succeeded in wiping out hog cholera, wiping out hoof and mouth disease and putting an end to the huge livestock losses caused by the screwworm. Even today we still guard our borders against these diseases to protect against reinfection. It is just as important that we have the same dedication to wiping out brucellosis, a disease which still exists within our own borders and which threatens to spread once again if we do not take action now.

The rapid completion plan is well considered, is feasible and has the backing of the industry. With this plan, we can reach that light at the end of the tunnel for brucellosis eradication.

Thank you, Mr. Chairman, and I will remain to answer any questions.

[The prepared statement of Mr. Holcombe appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you, Dr. Holcombe.

Our next witness is Dr. Taylor Woods, State veterinarian and director, Arkansas Livestock and Poultry Commission, Little Rock, Arkansas.

Dr. Woods, you may proceed.

STATEMENT OF TAYLOR H. WOODS, DIRECTOR, ARKANSAS LIVESTOCK AND POULTRY COMMISSION, AND VICE CHAIRMAN, U.S. ANIMAL HEALTH ASSOCIATION BRUCELLOSIS COMMITTEE

Mr. Woods. Thank you, Chairman Stenholm, distinguished members, ladies and gentlemen, for the opportunity to testify before this august committee concerning brucellosis.

I am Dr. Taylor Woods, director of Arkansas Livestock and Poultry Commission and vice chairman of the USAHA Brucellosis Committee. I thank you for the privilege of appearing to exchange information at this grassroots level of our neighboring States.

We, in Arkansas, feel that the eradication of brucellosis is a must situation. Our Governor, Bill Clinton, and Jim Baker, chairman of our commission as well as our full commission, are totally behind our eradication effort. With the help and support of our Farm Bureau and Cattlemen's Association, we strive to make each individual player in the disease eradication effort aware of their responsibilities. These individual players being producers, veterinarians, market operators, traders, State and Federal workers, Extension agents, and the general public.

We have seen without proper education efforts being produced that any one of the aforementioned segments can greatly hinder the eradication move. I believe that now is the most important time for the players to be in a position to do their part.

We, in Arkansas, have 65 infected herds. We are looking to go to class A this fall, and with the attitude of the general public and producers in the State, we are moving forward with our program. But we need to take a look at what is happening to the Federal Government. Since the Federal Government has said that they will be out of the program by budget year 1991, a State has the following options.

First, a State may do nothing but go downhill with its program. Second, the State can abide by what money alone APHIS gives them. Third, a State may develop its own monetary program to carry it through eradication, or fifth, encourage APHIS to adopt the rapid reduction plan or a completion plan.

Option No. 1: Arkansas has seen its share of hard times for brucellosis. Since 1973, we had 250 infected herds. From there, we hit a peak in 1984 with 691. We were declassified from B to C in August of that year. We regained our class B in January 1987, and are looking forward to a class A at the end of this year.

We have seen this move cost our producers millions of dollars because we could not be competitive with the neighboring States for breeding animals. Presently, we feel it cost us \$8 million a month

to be in class B. We feel for us to move to class A, that not only the monetary situation must be handled, but internally our regulations and laws, with the proper follow through with compliance, has to be in order. So you see we cannot do nothing.

Option 2: We feel that APHIS funding will either be reduced or nonexistent in their 1991 budget. This is the appointed time when funding is to be reduced to \$35 million and the VMO's and AHT's are to be reassigned to problem areas outside of brucellosis, except for monitoring and compliance. At this level of funding, it would probably be the year 2000 before we could be free of the disease, so this is not acceptable to us.

Option 3: This is where the State of Arkansas is and wants to maintain. We expect nothing but the very best from our brucellosis program, as we can see this is the only way for us to be free. We believe the Federal Government when they told us they were going to be out of the brucellosis program in their 1991 budget year, and we developed our program accordingly.

We started advising our industry 3 years ago of this move and in working with the industry and legislature, we passed a \$1 check-off program this last legislative session and it is now in effect. This check-off works exactly like the national beef check-off except that we keep all the money. The check-off is \$1 per head for each animal that changes hands, whether they be at the market or at the farm. This check-off will replace the loss of Federal funds and be able to maintain a strong brucellosis program in the future. Our \$1 check-off is built into the budget, so we do review it each 2 years. Our legislative session is every other year. We are on a biannual situation.

Option No. 4: This could probably be another great effort through our States if APHIS would adopt the rapid reduction plan. This plan was developed by Dr. Glosser and his staff at the request of the National Cattlemen's Association. It has been reviewed and resubmitted to APHIS as an acceptable plan. Of course, the problem here lies with funds for the program. There are a few indications at this time that the plan is reasonable because: One, we have only 1,900 plus infected herds in the United States; two, when we look at overall funding levels and eradication points within certain States, we feel this is the only way some States will be able to carry out their eradication plan; three, as long as there is a foci of infection in the United States, then all States are still at risk; and four, since most of our livestock today are in free and A States, those States with infection are paying for the disease monetarily and still being hurt within their respective industries. In other words, I cannot be competitive with a free or A State for breeding purposes at this time.

The rapid reduction plan could be of great importance to the States like Arkansas and Oklahoma if we reach free status before Louisiana and Texas, because the 1990 funding year for APHIS reduces their budget \$10 million and this had a large impact on several States. If we follow the same scenario and continue reducing the budget to \$35 million as projected, then work will stop in several States.

However, to spend money without a State's monetary structure being sound toward eradication meets disfavor with my commis-

sion. We feel that a short length of time should be used in working the rapid reduction plan. We also feel that all of the small details should be in place and the UM&R should be followed exactly if a State is going to progress with the Federal tax dollars. In our opinion, laws and regulations necessary to carry out the rapid reduction plan should be in place before money is offered or at least at the same time money is offered. Some States will not be in a position to carry forward the rapid reduction plan even if funds are available. So, caution should be used here for progress to be monetarily worthwhile.

New technology must be used. The PCFIA and/or ELISA test systems allow us to concentrate more on the truly field infected herds. This new technology also affords us a better use of adult vaccination and calfhood vaccination. With the use of the liquid adult vaccine and taking advantage of depopulation where feasible, we can reduce or stop the community spread of the disease. In Arkansas, we are presently requiring herds to be either depopulated or adult vaccinated as ruled by the designated epidemiologist.

Mr. Chairman, the State of Arkansas is not only interested in our program, we are interested in seeing this disease eradicated nationally. Calfhood vaccination is an area that is going to be talked about in certain States to be stopped and we simply cannot allow this to happen until all States are free. We must see some leadership developed at the Federal level to guide the disease control, the funding level, and the compliance level to continue to work with the States for eradication.

Arkansas itself is set and ready. We feel we can handle our problems, but we will be haunted thereafter by a foci of infection outside of our State until all States get to the same level of infection, which is free.

Thank you for this opportunity, Mr. Chairman. I would be happy to answer any questions.

[The prepared statement of Mr. Woods appears at the conclusion of the hearing.]

Mr. STENHOLM. For the record, Dr. Campbell, director of the division of animal industry, Florida Department of Agriculture was inadvertently unable to be with us today as previously stated. If he submits a statement, it will be placed in the record.

Question, Mr. Watkins.

Mr. WATKINS. Yes.

Dr. Hartin, do we have a—maybe I should say it another way here—are we being penalized on any cattle that they send out of the State or is it the general population of the cattle?

Mr. HARTIN. I think any State that is a B or C area has a reduced marketing ability of their cattle because of the stigma of the disease. As a class B State, we do not have any additional restrictions on us today, but we will have in another year. But we have less people looking at our cattle to buy.

Mr. WATKINS. If those restrictions go in, how much is that going to cost the State, the cattle people of the State?

Mr. HARTIN. Literally millions of dollars. It would be hard to calculate what it would cost, Congressman Watkins.

Mr. STENHOLM. When is that supposed to go into effect?

Mr. HARTIN. October 1990.

Mr. WATKINS. If that is going to cost us millions and we have 138 herds in Oklahoma, 4,000 head roughly you indicated. That is all we have.

Mr. HARTIN. That is correct.

Mr. WATKINS. How much is the State spending right now, today, in carrying out their phase of the brucellosis eradication that—say the total amount and also if we got rid of that 138 herd infected, what reduction would that be to the State cost?

Mr. HARTIN. Present budget for the eradication program in Oklahoma is approximately \$3 million a year. Of that, about \$2.5 million is State funds.

Now, we are doing some depopulation, and the State has appropriated this past year \$150,000 for depopulation. That is not adequate.

Mr. WATKINS. How much to eradicate those or rid yourself of those 138 real quickly? Buying them up, disposing of them, how much could we possibly save?

Mr. HARTIN. You would save considerable from the standpoint of manpower of testing and this type thing. One thing we must keep in mind that right now we have 138 known infected herds. That is not to say if they were all gone today, there would not be another infected herd out there. There is still additional infection as evidenced by the fact that we find additional herds each month as is true in all B or C States.

But certainly to remove that foci of infection to spread to neighboring herds would be a tremendous asset and speed up the eradication process.

Mr. WATKINS. Yes, I am just trying to do a little figuring on how to cut our loses more ways than one for the cattle industry and the total taxpayers. You know, and I do not know, that is I want to pursue it later on, a lot of our people have—I know we are doing some research on this—have little confidence in the overall Strain 19. I think it is the best we have been able to come up with the last few decades, but trying to find a solution to that, and I know we are doing some studies about infected herd or whether it is coming from the vaccine or not, et cetera. So hopefully, we can find something to build some confidence in our cattle people out there in some of the vaccine.

Arkansas has 65 herds. They have come a long way.

Mr. WOODS. Yes, 690.

Mr. WATKINS. What are you going to use the dollar checkoff for overall?

Mr. WOODS. We will be using it for some part-time people who will be using it for cattle vaccination.

Mr. WATKINS. On a 65 herd, you are all not too far from—in other words, it may pop back out or something.

Mr. WOODS. Right. We are looking to qualify for class A. We can have 85 newly infected herds a year and qualify for class A. So we are getting our business well in order. We are only nine herds above being able to qualify at this time.

Mr. WATKINS. Well, if Arkansas can do it, we can do it.

Mr. HARTIN. We anticipate making it a year from now.

Mr. WATKINS. Before October 1990?

Mr. HARTIN. That is the goal. We think we can, by the skin of our teeth, make it by then.

Mr. WATKINS. I would sure say let us make that our goal.

I have some other questions for the record that may pop up here in a minute.

Mr. Chairman, thank you.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. Thank you, Mr. Chairman.

I have to confess a certain amount of ignorance not having kept up with the technology. I was a beefman in Minnesota and, of course, we were certified free and went to the market testing quite some number of years ago.

But when you talk about depopulation, are you talking about whole-herd disposal, or are you talking about when there is, and I am kind of curious, because as I recall it was never permissible in Minnesota to have adult vaccination. In fact, even our calfhood vaccination, we had a calfhood vaccination prior to a certain age of an animal we were not allowed to vaccinate beyond, I believe, 8 months. There was quite a controversy as to whether there would be a carryover even at 8 months of age of vaccination.

Is it the practice when you find brucellosis in a herd that that infected animal is shipped to market and then that herd is retested until it tests clean? Is that the kind of practice?

I can realize that I am talking with different types of cattle industry where you have a range situation where in Minnesota we did not have that many animals on a range. They were farm-confined.

Mr. WOODS. Yes, sir. In Arkansas, when we find a reactor, she is branded and removed. And then the herd owner is offered depopulation or adult vaccination.

And we have an infected herd that had four animals in it. We wanted to depopulate that herd. He would not allow us to. We went ahead and adult vaccinated a couple of animals just because he wanted to keep them. But we do the whole herd work, and we—the whole herd, as Dr. Billy Johnson said, we are talking about the females in the herd. The steers and heifers are separate, but everything else. Every female is dealt with.

Mr. STANGELAND. Can you ever expect to completely eradicate if you continue adult vaccination?

Mr. WOODS. Yes, sir. With the advent of the liquid vaccine, what we call liquid vaccine, adult vaccine, with the PCFIA machine, we feel real comfortable in doing that at this present time.

Mr. STANGELAND. Is indemnity paid for those adult animals that are marketed as reactors?

Mr. WOODS. We stopped paying indemnity in Arkansas in 1984. We do not pay them to have the disease.

Mr. STANGELAND. I have no further question, Mr. Chairman.

Mr. STENHOLM. This committee would like to commend each of you for your leadership in your respective States. In many instances, but particularly in the area of the biotech advances and the PCFIA testing procedure that was approved. I think hindsight, always being 20/20, will show that to have been a very good decision.

Today, we see that as we progress to the point to where eradication is close, I think it is also becoming very perceptive to the industry, and there is a change in attitude. I hope, Dr. Holcombe, you would concur that there is a recognition now that any State in which any individual perceives a right to continue to harbor the disease in their herd is going to cause their friends and neighbors a lot of pain.

Any comment concerning some of the difficulties that we have had in Texas with this extreme belief?

Mr. HOLCOMBE. We have a few, Mr. Chairman, and I think Mr. Owen, who is on the panel a little later, can speak to this very well. But we have seen a real turnaround in the attitudes of producers in Texas toward the program. And I think that has come about because of reduced dose, that we are making a real effort, Representative Stangeland, on these infected animals, and we are also seeing neighbors now turn in their people. They are selling cattle without testing, or this is—I do not want this man infected because he is next to me.

But what you said is very, very true, and it has been true, and occasionally we run into it. But I think we are overcoming it.

Mr. STENHOLM. Dr. Hartin, in your statement you said:

It is my opinion that these resources currently expended in vaccination research could be better used and should be directed into another area that would have a more positive impact on final eradication.

Dr. Holcombe and Dr. Woods, do you concur?

Mr. WOODS. Frankly, yes, sir; I do concur.

I feel that we know enough about things to eradicate. I am not sure what benefit a vaccine would have if he had a kill vaccine today that we could put on the table. It would take a tremendous amount of time to get this vaccine into the producer's hands, get him educated even as to double vaccinating the animals each year.

But yes, sir, I do concur that we need to put our resources into the final eradication effort and get on with it.

Mr. HOLCOMBE. Mr. Chairman, I certainly support research in any animal disease and human disease, and I just think that we have to continue this way. But I would have to say that I am also in agreement with Robert and Taylor that compared to the rapidity or the money funding the rapid reduction plan, or funding research over the next 5 years, I think that it would really be eradicated in 5 years if we had the money in the rapid reduction plan.

Mr. STENHOLM. Mr. Watkins.

Mr. WATKINS. Yes, a couple of last comments. Charles was talking about cutting his teeth, getting cussed out. I kind of cut my teeth in brucellosis, my own cattle getting banged out. But also abortions of a lot of them. In my part of the country when I was graduating from high school, I did a lot of removing the after-birth of these cattle and that's how I got my education.

You said something about reducing the Federal dollars like \$10 million. One of the things we are supposed to do is to make certain that they were still targeted where the hot States, or the States that still have the problem, just spreading the butter thinner. In other words, try to get back to the heart of this.

How much has the State been reduced in Federal dollars on the brucellosis program? It depends on what you have been reduced, you are still considered hot States. You are supposed to be targeted.

Mr. HARTIN. Congressman Watkins, I do not have that figure immediately available. Let me state it this way. Total dollars was not reduced at all in our State, but total dollars available to the program activities that we had done the year before was substantially reduced.

And the reason for that was that even though the PCFIA machine is a great instrument and is needed and we are utilizing it, the value or the cost of supplying that was figured into the appropriation to the State. Therefore, it was taken out of other program functions that you had the year before.

So the total dollars in Oklahoma is the same except a large part of it is directed to a specific area, and you have to absorb that loss in the other program functions.

Mr. WATKINS. Paul Jackson just reminded me that everyone was in agreement with that drop of \$10 million because the progress had been made, that \$10 million—that is industry as well as all the agency people.

One quick question for the record, and you do not need to answer right now. But what percentage of these affected herds remaining are registered cattle?

My friend from Minnesota, OK, we have a lot of ranch cattle, just cattle, strayed cattle, not registered cattle, registered herds and all. I am just trying to get a percentage of maybe what might be a high dollar volume in depopulation if it comes about.

Would you have that later on and provide that? I might be asking that for the Federal level. Give us a little insight, profile of what the remaining herds are, just bred cattle or registered cattle.

Mr. HARTIN. Congressman Watkins, I certainly will from Texas. But very few of your registered cattle herds are infected anymore. That is true in Oklahoma.

[The information follows:]

Of the 135 known affected herds in Oklahoma only four (4) are registered. These four (4) registered herds contain a total of 172 cattle. We do not have any affected dairy herds. Of the remaining 131 affected herds, 59 contain less than 50 cattle; 36 contain between 50 and 100 cattle; 25 contain between 100 and 200 cattle; 6 contain between 200 and 500 cattle; and 5 have over 500 cattle. Of the 135 affected herds, 55 are presently adult vaccinated and are expected to clean up in a very short time.

Mr. WATKINS. That is the way I feel about it. I feel certain that the problem has gotten minute, and so we are not talking about the more powerful, higher-priced cattle that we are trying to depopulate. We are talking about the more commercial-type cattle.

Mr. HOLCOMBE. Very true, sir. We have one dairy herd under quarantine at this time out of the 65. And there would be very few, if any, pure bred herds that would be involved.

Mr. WATKINS. Just give us a little indication about cost a little later on if you happen to have that.

Mr. STENHOLM. Arlan, doing quick arithmetic, Texas has 1,113 infected herds; Oklahoma, 138; Arkansas, 65. That is 1,316 herds out of a total of 1,900 in the United States?

Mr. HOLCOMBE. Mr. Chairman, we have 715. That 1,100 was for the year, for the previous year. Presently, we have 715 under quarantine.

Mr. STENHOLM. 715; Oklahoma, 138?

Mr. HOLCOMBE. Yes, sir.

Mr. STENHOLM. Arkansas, 35?

Mr. HARTIN. Yes, sir.

Mr. STENHOLM. Which gives 915 out of 1,900 in our three States.

I think the point here is the pressure is really going to be on the three States represented at this table in the overall aspect of the program.

Mr. STANGELAND. Let me ask another question.

We are so close. With that number of herds in the total United States infected, we are so close to complete eradication.

In your opinion, would it help at this time to bring back an indemnification program to encourage those who are recalcitrant on the rights on their ranges with their cows if there was some way of being sure that when they have marketed that animal, that she brought back to them full breeding value as opposed to slaughter value, because she may have more value as a breeding animal than a slaughter animal?

Mr. HOLCOMBE. Well here again, it depends strictly on the market situation, what these animals are bringing.

But in Texas, we have never had very much depopulation. We always had a lower level—I do not mean depopulation. I mean indemnity. I do not think the indemnity, selling the affected animal is what we are really talking about. I think that if the owner had the option of selling this small group of cattle and not having to gather them every 60 days, or go through all of this and the agony of not being able to sell, and the neighbors, go through all that, I think it would be very beneficial. I really do, to get rid of all this much source of infection. Because even though the herd is under quarantine being tested, it does not totally prevent it from spreading some infection to another herd somewhere until we have the last reactor out of there.

So depopulation, to us, has tremendous merit to do a really great big step on getting final control of it.

Mr. STANGELAND. Thank you.

Mr. STENHOLM. No further questions, gentlemen. We thank you very much for your time and your participation in this hearing.

I would like to call Mr. David Shaw, Dr. Workman, and Dr. Gary Adams.

We welcome this panel.

Mr. SHAW. Mr. Chairman, with your permission, I think it would be to the advantage of the hearing if Dr. Workman's testimony was to be presented first.

Mr. STENHOLM. Yes, Dr. Workman can present his testimony first.

STATEMENT OF ERWIN F. WORKMAN, JR., VICE PRESIDENT, RESEARCH AND DEVELOPMENT, IDEXX CORP.

Mr. WORKMAN. It is certainly a pleasure for me to be here today, and I appreciate the opportunity to review the evolving diagnostic

technologies that have and will continue to positively impact our ability to eradicate important diseases of animals such as brucellosis in cattle.

Examples of such technologies are shown in the first slide.

As most of you know, immunoassays have been around for a long time, but they continue to evolve in terms of accuracy, ease-of-use, and automation. DNA probe assays, on the other hand, are just beginning to come onto the scene but offer possibly the ultimate in terms of specificity. And finally, biosensors offer the potential for foundation pen-size dip and read systems which can be used in the laboratory as well as in the field.

Immunoassay systems have evolved dramatically over the last several years from the early systems shown here which include simple agglutination tests, coated tube tests, coated bead tests, microtiter plate tests to sophisticated sample-in-answer-out systems as well as quick, easy-to-use and accurate in-field or in-clinic systems.

Such advances in immunoassay technology have been applied to laboratory and in-field testing for *Brucella abortus*.

The IDEXX PCFIA test system, as shown in this slide, is a fluorescence-based automated immunoassay system which provides sample-in-answer-out capability to the laboratory. To perform this assay the technician simply pipettes samples into the 96-well plates, loads 10 plates into the magazine of the instrument, and pushes go on the touch screen. The instrument performs the rest of the assay protocol automatically as follows: From adding antigen-coated particles to sending data to an IBM computer which calculates, prints out, and stores results.

The throughput capability of the system is shown in the next slide. As you can see, one instrument with one technician can perform three runs a day, or approximately 3,000 samples per day which extrapolates to approximately three-quarters of 1 million samples per year. In addition to this automated system, a less automated instrument is available which may be more appropriate for smaller laboratories. Furthermore, it is relatively portable and, in fact, has been taken to large ranches for on-site testing.

PCFIA benefits for brucellosis testing include enhanced sensitivity, reduced labor, quicker throughput, and increased specificity; all of which equate to better results with no increase in costs.

An additional benefit for the PCFIA system is that it is capable of simultaneously testing for multiple diseases since it can monitor up to four different wavelengths.

In the next slide you can see results from such a combination test for antibody to *Brucella abortus* as well as antibody to infectious bovine rhinotracheitis. Brucellosis results are shown in green while the IBR results are shown in red, and there are examples of both positive and negative for each disease. Utilization of the PCFIA system for simultaneous testing obviously increases the efficiency of testing programs since the majority of the expense is in the cost of sample collection.

Responding to the need for a highly specific in-field assay with sensitivity matched to the PCFIA system, we employed our state-of-the-art membrane filter technology that a lot of you know as CITE. The CITE brucellosis test is a USDA licensed product, has built-in controls, is quick and easy to use, and has improved sensitivity and

specificity compared to the products now used in in-field situations such as the livestock market.

Performing a CITE brucellosis test requires a five-step protocol, and about 10 minutes total time. Results are interpreted by comparing the color that develops in the sample spot, which is in the 12 o'clock position, and that is the position right under the little black dot, with the color that develops in the standard curve at the 9, 6 and 3 o'clock positions.

The low control in the 9 o'clock position is calibrated to the 0.7 cutoff in PCFIA, while the control at the 3 o'clock position is calibrated to the reactor level cutoff at 0.25 in PCFIA. At this point the CITE brucellosis test is primarily used on vaccinated animals that test CARD positive at the livestock market.

There are now many examples where subsequent testing with CITE has been negative and follow-up testing by PCFIA, complement fixation, and Rivanol, have confirmed the negative CITE result. For example, this calfhood vaccinate tested CARD positive and CITE negative at the market. Supplemental lab testing showed negative on PCFIA, Rivanol, and complement fixation.

In another example, the CARD test was positive on an adult vaccinated animal while a CITE test run at the market was negative. Again, lab tests showed PCFIA, Rivanol, and complement fixation to be negative.

This is not to say that the CITE test lets all CARD positives off the hook and as shown in the next slide the CITE test confirmed the CARD positive at the market. This animal was subsequently classified as a reactor with Rivanol and complement fixation.

Furthermore, CITE was compared to the CARD test in a study of 714 culture positive animals. The CITE test identified approximately 1 percent more true positives than the CARD test.

Even the CITE technology continues to evolve and IDEXX has already introduced into some of our markets a new assay device called CITE probe. CITE probe further simplifies immunoassays without sacrificing accuracy or multiple analyte capability by eliminating the need for accessory bottles of reagents, measurement of any volumes, and refrigeration.

In terms of simplicity and ease-of-use, however, the ultimate tool for a diagnostician would be a device that could be simply placed in a sample and within a few seconds provide an electronic readout of the result—such as the one now does measuring the pH of a solution. Biosensors offer this potential.

For your information, I have defined biosensors as the synergistic combination of biochemistry and microelectronics where immobilized biological materials like antibodies or enzymes are in intimate contact with some transducer device which converts a specific molecular recognition into a quantifiable signal. We have an active program on biosensors and hopefully in the near future we can bring this technology to bear on animal health issues such as brucellosis surveillance.

Finally, another technology that has been rapidly evolving from a research tool to a practical diagnostic method is the DNA probe assay. Within a couple of months, we will introduce the first nonisotopic DNA probe test into the veterinary marketplace. This assay

will be a test for the presence of mycobacterium paratuberculosis which is the causative agent of Johne's disease in cattle.

This test appears to be more sensitive and more specific than the current culture methodologies which can take months to produce results. It is conceivable that a DNA probe test could facilitate the confirmation of *Brucella abortus* infections by replacing the current 6-week culture procedure.

In summary, it seems clear that the evolution of diagnostic technologies driven by advances in biotechnology and electronics has had and will continue to have a very positive effect on our ability to diagnose and eradicate diseases such as brucellosis. I would urge this committee both to maintain an awareness of such technologies and their potential impact on the livestock, poultry, and dairy industries and to take the appropriate actions to support their rapid implementation even when substantial changes to current systems are required.

Thank you very much.

[The prepared statement of Mr. Workman appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you, Dr. Workman.

Next, Mr. Shaw.

STATEMENT OF DAVID E. SHAW, PRESIDENT, IDEXX CORPORATION

Mr. SHAW. Thank you, Mr. Chairman and members of the committee. It is a pleasure to be here today to discuss the role of new technology in the eradication of bovine brucellosis.

I am sure that I share the view of many people here today when I say that the timing of this hearing on the subject of new technology is particularly opportune. In the past several years we have begun to witness a technological revolution of major proportions in biological science. It is a revolution that will rival in its proportion and in its impact the revolution in electronic technology that began several decades ago.

Among its many other benefits, the biotechnology revolution has very important implications on the ability to quickly and accurately detect animal diseases as well as contaminants in food and feed. As others here have discussed today, brucellosis surveillance has already benefited considerably from this revolution, and the opportunity exists to significantly broaden this impact in the future. This opportunity applies not only to the brucellosis program, but to the control and eradication of other economically serious diseases in livestock and poultry, and again to a broad range of food and feed contaminants.

Because of my company's particularly strong expertise in biotechnology-based diagnostic and surveillance systems, I would like to focus my remarks on several issues related to this specific area.

First of all, I would like to acknowledge the very supportive role that this committee and others in the room have played in the recent and very successful introduction of several important new technologies to the brucellosis program. Both CITE technology and PCFIA technology, which have been mentioned by others here today, have received a great deal of support by members of this

committee, by State and Federal officials, and by the cattle industry.

Thanks to this assistance, these powerful new technologies have begun to have a very important impact on the accuracy and speed of brucellosis testing in many States. PCFIA is now used at 25 sites in 17 States to test roughly 10 million samples per year with unprecedented accuracy. CITE is used in more than 25 States to reduce the adverse impact of inaccurate test results in field testing situations such as cattle markets.

In view of the theme of today's hearing, an important point to make regarding the new CITE and PCFIA technologies is that they represent a very noteworthy trend toward far greater use of private sector technology in a market traditionally served largely by government sources.

Unlike most other technologies and surveillance systems which preceded them, CITE and PCFIA were developed with private capital.

However, the successful implementation of these systems has required a very unusual and possibly unprecedented degree of interaction between government livestock officials and private industry—in this case, IDEXX Corp.

Given the increasingly crucial role that private industry will clearly play in providing technology for surveillance of brucellosis and other animal diseases in the future, the encouragement of such interaction should become a higher priority objective than ever before. Issues to be considered in this regard by this committee and other policymakers range from the efficient evaluation and approval of new tests and technologies, to creation of new structures for cooperative public/private development programs. We believe that expanded public/private cooperation of the kind that has led to successful implementation of PCFIA and CITE technologies will be of great benefit to the cattle industry in the future.

Another point for consideration in the context of this hearing is that technologies applicable to improved brucellosis surveillance will also have great value for the detection of other animal diseases and, as I mentioned earlier, for the detection of food contaminants. PCFIA technology provides a good illustration of this point.

This technology allows for simultaneous detection of multiple diseases on a single sample with little incremental effort by laboratory personnel. This unique technological capability has potentially far-reaching implications for the livestock industry. Samples collected at substantial expense for brucellosis testing and other programs such as swine pseudorabies could potentially be tested—very cost effectively—for other diseases which have adverse economic consequences for the U.S. livestock industry.

Diseases such as IBR and BLV in the beef and dairy industry are increasingly the target of eradication efforts in various parts of the world such as Europe. The same is true for various poultry and swine diseases, and we have seen a great deal of interest in improved surveillance for food contaminants such as mycotoxins, drug residues, pesticides, and microbial pathogens.

New technology will play a crucial role in dealing with these issues. And, while today's hearing focuses specifically on new technologies for brucellosis applications, it seems very appropriate that

broad consideration be given to the use of these new surveillance technologies for other important applications benefiting the U.S. livestock industry. Never before have technological capabilities offered the opportunities available today for very rapid and accurate detection of a broad range of analytes.

I would also like to briefly address the subject of financial resources needed for the successful implementation of new surveillance technologies. Because the implementation of CITE and PCFIA technologies were novel programs, no established mechanisms were in place for their implementation, and their success to date has been the result of extraordinary efforts by many State and Federal officials. An important obstacle to overcome, for example, was that the early stages of implementation of new technology frequently require a commitment of expanded financial resources. This is necessary even though the rationale for introducing new technology is ultimately to reduce rather than increase cost and to improve the economics of disease control efforts.

Needless to say in a time of tight budgets, the potentially great benefits of technologies such as PCFIA and CITE and others can be jeopardized by wavering of support in the often frustrating but very crucial early stages of implementation. The need now exists to implement PCFIA in as many as 10 additional States and to add computerized data processing capabilities to maximize the utility of this technology in the final eradication of brucellosis.

Without the commitment of adequate financial resources, the power of this or other new technologies will be lost and a very successful new program will be stifled before it is able to return significant benefits to the cattle industry.

The same is true for surveillance systems applicable to other animal diseases and food contaminants. The considerable power and potential benefits of these technologies simply cannot be realized without a commitment to significant levels of investment spending in the first several years of the new program.

In this new era of increasingly sophisticated disease detection technology, I believe that the barrier to better disease surveillance will become more a matter of resources and organizational structure than technological ability. Innovative but proven structures such as the National Poultry Improvement Program offer successful models for cooperative government and industry initiative to address the eradication of animal diseases and food contaminants. This kind of program applied to livestock industries could offer great promise in addressing a broad range of health monitoring needs.

We envision that diseases such as bovine leukemia, Johne's disease, IBR, swine pseudorabies and others will increasingly come to the forefront of livestock disease eradication efforts, and in fact this trend is well underway in Europe and other parts of the United States.

Technologies now being applied to brucellosis eradication can impact these technologies with the assistance of an unprecedented level of private capital and private initiative if appropriate programs are put in place to accomplish this.

In summary, I believe that this hearing comes in the midst of an important new era in the evolution of surveillance technology and

therefore at an extremely opportune time for considering ways to harness these new technologies for the benefit of livestock producers. It is clear that improved surveillance via new technologies has the potential to significantly improve the economics of animal industries and to better ensure the wholesomeness and safety of animal-derived foods such as beef, pork, poultry, and milk.

If the appropriate resources are made available, brucellosis eradication should be a relatively short-term objective given the increasingly sophisticated tools available to accomplish this, and the commitment reflected in plans such as the rapid reduction plan.

Longer term, we hope that the technological capabilities that have been brought to bear on the brucellosis program and other applications such as poultry diseases and swine pseudorabies can be applied to a much broader range of needs. However, this will not happen in the absence of positive action by public policymakers. Neither consumers nor producers will benefit from these opportunities without an appropriate allocation of resources and a new era of creative public/private relationships to facilitate the implementation of new technology.

Again, thank you for inviting me to discuss these issues. I would be glad to answer any questions that you may have.

[The prepared statement of Mr. Shaw appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Next, Dr. Garry Adams, department of veterinary pathology, Texas Veterinary Medical Center, Texas A&M University, College Station, Texas.

STATEMENT OF LESLIE GARRY ADAMS, PROFESSOR, COORDINATOR, BRUCELLOSIS RESEARCH PROJECT, DEPARTMENT OF VETERINARY PATHOLOGY, COLLEGE OF VETERINARY MEDICINE, TEXAS AGRICULTURAL EXPERIMENT STATION, TEXAS A&M UNIVERSITY

Mr. ADAMS. Committee members, Mr. Chairman, ladies and gentlemen, I am pleased to provide testimony today on the subject of technological advancement toward the completion of eradication of brucellosis, past, present, and future. I will attempt to review the general technological accomplishments from a scientific perspective and I have provided you an outline, focused outline, of what I view those to be.

I have to say that these reflect my personal opinions in looking at the accomplishments in research, from reading the literature, and from actively participating in research, and recently sponsoring an international symposium with several speakers I have drawn from that data base.

I have divided my presentation in to time sequences: The distant past, the recent past, the present, and the future. I will touch on the distant past first.

This has largely been done for me already by Dr. Johnson and others, but one point I would like to make is that the early brucellosis program reduced disease incidence to a level that control became feasible. I emphasize the word "control." This was done in

spite of having good technological base, adequate funding, and other deficits. Significant progress was made in the past.

One of the deficits that they had at that time was the lack of a scientific basis to make good judgments in selection of diagnostic tests and development of improved vaccines.

In the recent past, from the late 1970's until the present, two major events occurred in 1977 and 1978, and those have been touched upon by Dr. Johnson as well. When the reviews of the basic knowledge and the concept of eradication were looked at closely by the National Academy of Sciences group committee on brucellosis research and evaluation, and also the National Technical Brucellosis Commission.

They had several points that they made in their presentations, but I would like to focus on the issues related to research.

Discovery of fundamental new research concepts and contributions were found by them to be inadequate. There was a need for new serologic tests which would differentiate Strain 19 vaccine titers from field-strain induced titers. There was a need for improved vaccines that were safe. There was a need to define the components of the protective immune response that the cow makes against the pathogen. There was a need to know how the organism actually causes the disease. Fundamental information that had not been coming forward.

On the other hand, the National Brucellosis Technical Commission, in 1978, looked at the issue from a different viewpoint. They had some 11 major points that they put forward. I will not focus on all of those. The ones that I would like to focus on though is their first point that they made and that is control leading to local eradication of brucellosis is biologically feasible, and that the Uniform Methods and Rules evolved to contain barriers to the achievement of control leading to local eradication. And last, the one that I would like to focus on most is that research funding should be provided at a high sustained level to expand the fundamental knowledge base.

One of the major things that was lacking in the early program, as a result of those two major national and international reviews, the funding was increased for not only research programs, but for the regulatory program. And as a consequent of that, the incidence of brucellosis as you heard this morning has been drastically reduced. We have it down now to a good level. And the point that I would like to bring forward now is that the expansion of the fundamental knowledge has increased significantly. You heard some of the spinoff of technology that has been generated given this morning in this panel.

Another major issue that was addressed and significant progress was made had to do with the Uniform Methods and Rules. These were improved to be epidemiologically sound, yet there was a way that the plans could be implemented in a flexible manner. A herd plan could be developed with the producers. This is a very important issue that was addressed and made this program work much better than it had in the past.

Now I would like to focus on the expansion of the fundamental knowledge. Biotechnology has had a major impact as you noticed already this morning on diagnostics and vaccine development. I

will go into some more detail on that in just a moment when I speak about the present and the future. Electronic communications and computer technology has had a major impact on dissemination of information; the recording of infected herd movements and interpretation of data, handling of data on a national basis. Antibody detection procedures have been developed as you have just heard. The use of semiautomated, automated, and robotics technology is having major impact as you have just seen demonstrated and is demonstrated in other kinds of procedures that are being used.

Now let us come to the present. That is what happened from 1978 until the present. I would like to come now to the present status that we are in. You have heard what progress that the national brucellosis regulatory program has made. I will not reiterate those.

But one of the things that did come out of the interactions between the U.S. Animal Health Association and the Government officials, academic, private enterprise, is that there was a focused incremental increase in the amount of surveillance testing and vaccination. This was done in a staged manner. This is one of the ways that the progress was made. And this makes it increasingly difficult for the movement of animals in those States where there is a problem, but they are steps that are necessary to finally attain the goal of eradication.

What it has amounted to is that national eradication is becoming increasingly feasible. As you have seen from the data this morning, the incidence of brucellosis infection is greatly reduced.

Now I would like to focus on what is happening in the present with regard to the rapid expansion of fundamental scientific technology base. Modern molecular genetics has been applied to *Brucella abortus* and is being used to define the genetic basis of disease causation. Chemical, structural, and molecular properties of protein and carbohydrate structures on the surface of the organism are being increasingly defined. Molecular biology is beginning to unravel the basis for the invasion and the survival of *Brucella abortus* in the cow. Biotechnology points the way to identifying the protective antigens. This is one of the major clues that must be found and identified in order to produce a better vaccine, and also their spinoff from that kind of work to develop differential diagnostic assays. The protective immune response of the cow to *Brucella abortus* is gradually becoming clearer. Indeed, the finite mechanism by which the cow actually resists the organism is not completely known, but that issue is becoming clearer and clearer.

The genetic basis for natural resistance to brucellosis in cattle has now been documented and is being mapped. The cellular mechanisms for recognizing and killing *Brucella abortus*, how does this occur within the cell, those mechanisms are being defined better and better.

Killed and live subunit brucellosis vaccines have been developed in several laboratories and are ready for evaluation or are being evaluated now in laboratory animals, and to some extent in cattle.

Differential diagnostic antibody detection assays, antigen capture assays, and DNA hybridization probes for more rapid and accurate diagnosis have been developed in several laboratories and are being evaluated in laboratory models in cattle at this time.

Epidemiologic and econometric simulation models for brucellosis have been developed for regulatory programs decisionmaking. Many of the factors that you discussed this morning with regard to cost/benefit ratios can be tested in this econometric and epidemiologic simulation model. This is funded by USDA, I might add.

Let us now turn to the future. Those are the things that are going on right now and the progress that is being made in the cow, in the organism, and the interaction thereof is a spinoff from that.

Now, the future, this is a prediction on my part. I may well be wrong, but having been involved with brucellosis research since 1979, and interactive with a lot of scientists, these are some of my predictions of what I think will happen in the 1990's.

Many new discoveries will be made through basic research. We will have a genomic map, that is, a map of the genes of *Brucella abortus* will be completed so that we can identify the virulence factors, the diagnostic antigens, and the protective antigens. We will know the genetic basis for each one of those factors. We will know then the basis for the interaction between the *Brucella* organism and the host species, whether it is a cow, a bison, swine, or whatever the host species happen to be.

Antigens inducing protective immunity, we will have those identified, they will be cloned, and they will be expressed in other organisms.

The basis and regulation for the protective immune response in cattle will be defined. Genes responsible for natural disease resistance will be identified, cloned and mapped. The functional and structural basis of *Brucella* membranes and their antigens will be defined. The strategies by which *Brucella abortus* invades, survives, and causes abortion will be elucidated.

What good will this do to find out these answers to these basic questions?

The spinoff from that will be the implementation of basic research findings as to specific applications. The cloned *Brucella* genes will be expressed in other carrier organisms or deleted from the *Brucella* organism and form the basis of live subunit or deletion mutant vaccines which can be differentiated from field strain infections.

Monoclonal antibody-based fully automated immunoassays similar to those you saw demonstrated this morning will differentiate vaccination serologic reactions from field strain serologic reactions.

Confirmed diagnosis will then be determined by DNA probe hybridization, and this will be done within hours or less. DNA hybridization of sperm or white blood cell DNA will allow selection of cattle for natural resistance to brucellosis.

Transfer of bovine genes responsible for brucellosis resistance to fertilized eggs or ova will produce transgenetic animals naturally resistant to brucellosis.

In order to do many of the things that I have pointed out above and to accomplish those ideas and apply them, it will require approved procedures and regulations to evaluate these recombinant vaccines large domestic animals, facilities in which to do the research, and approved procedures and regulations to carry that out will be essential.

Obviously, we are not at the beginning of the issue of brucellosis eradication, but neither are we at the very end of the story. Rather, we are in the last few chapters of the book where the pieces of the mystery begin to converge, yet, before the final solution becomes evident. Clearly the last 10 years of basic brucellosis research have been important in providing a better understanding of how *Brucella* causes disease, the molecular basis of why cattle do or do not develop protective immunity, how various subtle changes in the structure increases or decreases the ability of the organism to survive inside the cow cells, and many other basic findings which do not really seem to be relevant to the eradication of brucellosis.

Yet, basic research often turns out to be practical. We often need to be reminded that research is a process and that apparent breakthroughs are really no more than advances in a very long continuum and are almost always a result of a great deal of previous research. That is to say new end-products of science are almost invariably the result of a long chain of small advances.

Thus, it becomes increasingly important to provide continued levels of adequate funding to nurture the sustained scientific process that results in new fundamental discoveries leading to practical applications. Indeed, sustained Federal support has been funded through USDA-Cooperative State Research Service, and Competitive Grants and Animal Health section funds as well as through the USDA/Agriculture Research Service and USDA/Animal Plant and Health Inspection Service funding. These funds support honorable national scientific competition which often leads to scientific cooperation in the quest for new knowledge pertaining to brucellosis in cattle.

Of course, the funds provided to the USDA are approved through the U.S. House of Representative's Committee on Agriculture and Agricultural Appropriations, and it is your generous support that has allowed the entire scientific national community the opportunity to address and pursue these issues to a logical and practical end. We as scientists are grateful to you for your support and respectfully request that we be allowed to write the final chapter in the book and solve the mysteries to complete the eradication of bovine brucellosis from the United States.

That ends my formal comments.

[The prepared statement of Mr. Adams appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Mr. Watkins.

Mr. WATKINS. First, if you do not mind me deviating. We have gone too far to make my friend from Minnesota welcome by changing this weather. Arlan, I will tell you what. It is as cold as the north country here.

Let me say I have been intrigued by the testimony here. Dr. Adams, yours definitely in many ways. Let me ask Dr. Shaw, did you use Federal research moneys to develop the technologies, working in the lab, doing a lot of research?

Mr. SHAW. No, we did not. It was exclusively private capital involved in developing these technologies.

Mr. WATKINS. I noticed in your testimony here, yours and Dr. Workman here, I think yours talked about the need for making sure we have appropriate allocation resources in the creating public/private relationship in this.

Allocation of resources, are you talking about revenue there?

Mr. SHAW. Mr. Watkins, by the way, as we mentioned Dr. Workman and I are from Maine and we also appreciate being made comfortable with these cold temperatures here this morning.

I think that the kinds of resources that we believe deserve highest priority are for implementation regarding surveillance technologies and not for research and development.

I believe, as other speakers whose opinions I respect greatly this morning have said, that we have the tools now to get the job done. And if we have the commitment and resources applied to implementation, we can get the job done. And I guess I agree with that opinion.

Mr. WATKINS. Let me ask Dr. Workman here. I noticed in your testimony you stated, "At this point the CITE brucellosis test is primarily used on vaccinated animals that test CARD positive at the livestock market."

Vaccinated animals, what has been proven previous to vaccination? I mean I am trying to find out—there is quite a bit of money that goes into the vaccination and go into the marketplace and all of that. I am trying to see if there is any ray of hope of doing the tests prior to all that to save a lot of cost.

Mr. WORKMAN. I am not sure I understand your question, but the rules—the product is licensed as a confirmatory test, if you will, to a CARD positive only on vaccinated animals where the vaccination history is known. And the issue is really that—I cannot give you the exact incidence rate, but there is a finite incidence of false positive results in a glutination type tests that have nothing really to do with the presence of antibody generated against the organism. And the CITE technology has been clearly shown to eliminate that problem.

It will, however, depending on the level of antibody even in the vaccinee confirm a CARD positive. So it is not the perfect test.

Mr. WATKINS. You might elaborate a little bit more, if I repeat part of your testimony here. You said, "There are many examples where subsequent testing with the CITE has been negative and follow-up testing by PCFIA and CF and Rivonal have confirmed the negative CITE results."

So that confirms the testing.

Mr. WORKMAN. Right.

Mr. WATKINS. "For example, this calfhood vaccine tested card positive."

Mr. WORKMAN. Right.

Mr. WATKINS. "And CITE negative at the market."

Mr. WORKMAN. Right. Well, there are two ways that could happen.

First of all, the CARD test could have been positive because of some sort of nonspecific agglutination reaction. Under those conditions the CITE tests would not detect it and then the confirmatory test in the laboratory, PCFIA, whatever, also would not detect that.

The other situation is that in calfhood vaccinates you can have a residual amount of antibody. The CARD test does not allow you to look at different levels, but rather, it is either black or white. It is either positive or negative.

The CITE test does develop the standard curve and it is calibrated back to PCFIA, so you could have a residual level of antibody which would not be atypical for a calfhood or an adult vaccinated animal that would be below the cutoff level in the CITE, and then you would call that animal negative and allow—under the rules now not allow that animal to move, but allow animals accompanying that animal at the market to move.

Mr. WATKINS. CITE tests identified 1 percent more positive than CARD test.

Mr. WORKMAN. It is only significant in terms of sensitivity and the fact that it does not detect fewer positives at the market because it is less sensitive. It detects fewer positives because it is more specific. During the course of our validation of PCFIA, we collected as many culture positive animals as we could. That amounted to 700 and some. We probably looked at a couple hundred thousand more negative animals. But we tested the CITE test on those culture positive to ensure that we were in the ball park in terms of sensitivity and we certainly are in terms of the tests that are currently used at the market.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. Is the CITE test used in anything other than at the market test? Is it too expensive to use the CITE test initially to include the need of marketing animals that have shown a positive when they actually were not positive when they were actually made?

Mr. WORKMAN. It is difficult for me to really comment what is too expensive. It is a product that we have introduced largely into the veterinary clinic markets. It is really the dominant test used for detection of feline leukemia, feline eggs, canine parvo virus, and so forth. It is very effective in the veterinary clinic, because typically the client comes in, you have a sick animal and you want a quick diagnosis, and all of those tests are run under 8 minutes. So the importance there is speed and allowing the veterinarian to treat the animal so the client does not have to come back.

In terms of cost at the market, I do not know what is too expensive. It is conceivable that the next generation of tests could drop that cost some.

Mr. STANGELAND. Well, it is obviously a more sophisticated, more accurate test as to whether an animal is positive or negative to brucellosis. I am wondering if it has a practical usage in an on-the-farm test, for instance, where a man may have 8 or 10 reactors on the normal test, and all of a sudden with this test finds out that he has 1 or 2 or none.

Mr. WORKMAN. I would say it is practical in terms of accuracy, and someone else has to decide on how practical it is in terms of cost.

Mr. STANGELAND. I have no other questions, Mr. Chairman.

Mr. STENHOLM. I know that probably most in this room are fairly familiar with biotechnology. But unfortunately, there are a lot of people who are not. But as I listen to your testimony, the field of

biotechnology is truly phenomenal as to the possibilities. The technology that you describe is phenomenal to me.

Mr. Shaw, I think you can expect to receive an invitation from this committee to come before us and talk about food safety. *Salmonella*, are you doing work in this area, and do you have any comment briefly that you might make in the ability to detect *Salmonella* with the new techniques that you have developed?

Mr. SHAW. Yes, I think some of the technologies that Dr. Workman described will clearly have applications for microbial pathogens like *Salmonella*. And I think we can expect to see surveillance capabilities there that are dramatically better in the not too distant future.

Mr. STENHOLM. When you say not too distant future, what are we talking about? Can you give me a range?

Mr. SHAW. Well, I think a good example of the best technology that we know of today for very accurate *Salmonella* detection would be through the use of DNA probe technology. As Dr. Workman described, we are reaching a milestone in that technology within 1 to 2 months here by introducing very accurate, simple to use DNA probe technology; specifically in this case for John's detection, but that is a bacterial pathogen as is *Salmonella*, and the same technology should be applicable there.

Mr. STENHOLM. As I said, I am sorry we do not have additional time to go into greater detail surrounding your testimony.

Thank you very much.

Call the remaining members of this panel: Dr. Alexander, Dr. Confer, and Dr. Simpson.

First witness, Dr. J.W. Alexander, dean, college of veterinary medicine, Oklahoma State University, Stillwater, Oklahoma.

Dr. Alexander.

STATEMENT OF JOSEPH W. ALEXANDER, PROFESSOR, MEDICINE AND SURGERY, AND DEAN, COLLEGE OF VETERINARY MEDICINE, OKLAHOMA STATE UNIVERSITY

Mr. ALEXANDER. Thank you, Mr. Chairman. I am pleased to be here with you today and add my welcome to you and the other distinguished members of the committee to the campus of Oklahoma State University in cowboy country.

Prior to my remarks, I would like to thank my colleagues, Mr. Rob Smith, Dr. Brian Espey and Dr. Louie Stratton for their assistance in the preparation of the testimony you have before you.

Oklahoma State University, the college of veterinary medicine and the college of agriculture have long held the view that it is not enough to accumulate, interpret, and store basic knowledge, but rather, to actively disseminate new knowledge and to provide technical assistance to our various external constituencies. Whether we call it extension, continuing education, or technology transfer, the goal has always been the same: To fulfill the mission of disseminating research for today and tomorrow.

We are in a unique position to carry out technology transfer as it pertains to diseases such as brucellosis. We take seriously our land-grant heritage and its three missions of teaching, research, and extension.

Brucellosis technology transfer had its beginning in 1982, following an agreement between ARS, the college of veterinary medicine and the Kerr Foundation to establish a Livestock Research Center at Hugo, Oklahoma. The Kerr Foundation, later the Kerr Center, had a twofold role: The day-to-day management of the facility and the cattle, and dissemination of results of studies conducted at the center.

In 1988, the college of veterinary medicine assumed these two roles as well as all associated funding. The college of veterinary medicine is currently actively involved in conducting research and assisting the dissemination of the results of that research.

We have long held the belief that over 80 percent of the problem of brucellosis eradication appears to be a lack of understanding of the disease by cattle producers and others, including veterinarians in areas of high infection rates.

In 1983, a target area was established which consisted of 5 counties in southeastern Oklahoma, 7 counties in northeast Texas, 12 counties in southwest Arkansas, and 2 parishes in northwestern Louisiana. The target area contained 9.5 percent of the known brucellosis in the United States, but only 1.3 percent of the total cattle herds in the United States. The area contained over 21,000 herds not known to be infected but considered to be at risk.

Technology transfer goals were established for this area which included: Information gathering about not only the disease prevalence, but basic demographic, socioeconomic, geographic, and economic information about the area; to develop a newsletter designed and targeted for selected audiences; to implement various mass media campaigns to present the factual information about the disease and its prevention and control.

In 1985, the target area was expanded to include the following States: Arkansas, Florida, Louisiana, Mississippi, Oklahoma, and Texas. These six States contained over 90 percent of the known brucellosis in the United States. Funding was supplied by both USDA, APHIS, and ARS.

In the interest of time I will allow my written testimony to verify the numbers and accomplishments of that project.

[The prepared statement of Mr. Alexander appears at the conclusion of the hearing.]

Mr. STENHOLM. Without objection, your entire written statements will be made a part of the record, and we do appreciate your summarization.

Mr. ALEXANDER. Thank you, sir.

I would like to add that in addition to some of the rather traditional methods of disseminating technology transfer, those of us involved with veterinary medical teaching hospitals have the opportunity to provide the best kind of technology transfer, and that is one-to-one interaction with producers, veterinarians, and others concerned with this problem.

Today, technology transfer has been accomplished primarily through rather conventional methods. In the future more use will be made of the new electronic technologies that are appearing daily. Agriculture in the United States is at a major turning point as it enters the information and communication age. In fact, some

agricultural scientists indicate that the computer is possibly the most significant technological invention in U.S. agriculture today.

In addition to computers, some of the new electronic technologies that will increasingly gain application in technology transfer include: Satellite delivery systems, video cassettes, interactive video disks, compact disks, electronic networks. The application of these and yet undiscovered methods of disseminating research for today and research for tomorrow will help ensure success in the battle for elimination of brucellosis and other disease problems in our livestock herds and flocks.

The college of veterinary medicine, the college of agriculture and others will continue working with individuals and organizations throughout the South to fight livestock diseases not through regulation, but by extending information and technology to producers, veterinarians and the general public.

Mr. Chairman, thank you for the opportunity to share this information on brucellosis technology transfer.

Mr. STENHOLM. Next, Dr. Anthony Confer, department of pathology, college of veterinary medicine, Oklahoma State University.

**STATEMENT OF ANTHONY W. CONFER, PROFESSOR AND HEAD,
DEPARTMENT OF VETERINARY PATHOLOGY, COLLEGE OF
VETERINARY MEDICINE, OKLAHOMA STATE UNIVERSITY**

Mr. CONFER. Mr. Chairman, I was asked to prepare my comments more in the direction of the research on brucellosis going on at Oklahoma State University, and I would like to acknowledge the excellent job that Dr. Adams did in summarizing the past, present, and future research in brucellosis as it pertains to a national effort.

Scientists at Oklahoma State University in the colleges of arts and sciences, the college of veterinary medicine, the division of agriculture, in conjunction with scientists at the National Animal Disease Center in Ames, Iowa, the Kerr Center, and the Oklahoma Experiment Station have all been actually involved in brucellosis research since 1982. And we have had predominantly three questions that we have been approaching.

The first is: How can the diagnosis of brucellosis be improved relative to testing in both accuracy and speed? Second, how does the causative bacteria, *Brucella abortus*, interact with the host in both susceptible and immune cattle?

And, third, how can a new vaccine be developed that stimulates better immunity and is safer than the current Strain 19 vaccine?

I will try to summarize my written testimony in these areas.

To the first question relevant to the diagnosis, I would like to acknowledge the work of Dr. John Bantle in the department of zoology, Oklahoma State University, who has been developing a new rapid diagnostic test which is extremely sensitive and highly specific for *Brucella abortus*.

This test uses the latest gene probe or DNA probe technology very similar to what Dr. Workman described IDEXX, Corp., is using in their tests, the polymerase chain reaction. And this assay detects the presence of *Brucella* DNA and is, therefore, analogous to culturing the organism. The polymerase chain reaction, howev-

er, is much more rapid and sensitive than conventional culturing techniques, and the assay can detect the DNA from a single organism. Currently, Dr. Bantle's laboratory has tested the system against DNA from 15 different bacteria, fungi, and viruses, and has failed to detect any false positive reactions against these other organisms.

It is envisioned that this test would be used predominantly for rapid diagnoses of *Brucella* infected fetuses that had been aborted and would greatly eliminate the sometimes 3- to 7-day culturing that is required right now to confirm the reaction. Additional testing needs to be done in this area.

I think one of the big areas in which progress has been made but probably not enough is in the area of understanding how the bacteria and the host interact, particularly in the susceptible and in the immune animal. Research in many laboratories, including ours and in conjunction with Dr. John Wyckoff at the college of veterinary medicine, have in the past and are currently studying immunity to brucellosis using cattle and laboratory rodent models.

We have shown that what is called cell-mediated immunity may be a very important part of the immune reaction in cattle. However, others in other laboratories using different assay procedures have not found similar results.

Dr. Wyckoff is currently undertaking a rather unique approach to understanding immunity on bovine brucellosis, and that his studies are centering around investigation of the molecules or the antigens of *B. abortus* that stimulate the immune system of cattle and understanding of the functional nature of the immune cells. He is currently concentrating his research on two types of white blood cells: The helper T cell, or helper lymphocytes, and the cytotoxic lymphocyte, and studying these to determine which particular part of the *Brucella* molecule stimulate these types of white blood cells. With the feeling that if we can understand which part of the *Brucella* stimulate these type of cells, then we will know what part of the *Brucella* molecule or which molecules we would put into a synthetic or subunit vaccine. So this is a rather unique approach I believe that he has, and one that he has made substantial progress in the last 2 years, and has recently been awarded U.S. Department of Agriculture, both special and competitive grants.

In the area of improved vaccines, let me say that I am in agreement somewhat with Dr. Cheville that the development of a subunit or synthetic vaccine to brucellosis is a difficult task. It is a very complex organism and the interaction between the bacteria and the host is a very complex one. So it is not as simple as the hog cholera, hoof and mouth disease, or some other bacterial vaccines.

In the past, nonliving *B. abortus* vaccines have failed to induce immunity in cattle. Vaccination with killed *Brucella abortus* vaccines such as the Strain 45/20 which was tried in Europe would stimulate antibody responses but no immunity. We conducted a study at the livestock health research center in Hugo, Oklahoma, using chemically modified and unmodified salt-extractable proteins prepared by scientists at the National Animal Disease Center. These vaccines induced an antibody response and some degree of

cell-mediated immunity, but failed to induce resistance to challenge with *Brucella abortus*.

The results of these and other studies have led to several observations. First, the immunity to brucellosis is still not well enough understood. Second, the important antigens that stimulate immunity are not known. And third, the appropriate adjuvants to be used in a nonliving vaccine need to be recognized. Adjuvants are substances that are added to nonliving vaccines to enhance the immune response of animals.

And so we have concentrated much of our efforts recently in study adjuvants which may augment the immune response of cattle to nonliving *Brucella* adjuvants.

I will let my written testimony go through the details of that. But let me say that there are several promising adjuvants that we have demonstrated—one being a recombinant DNA derived substance referred to as interleukin 2 which we will be testing in an experiment actually beginning next week down in Hugo, and it looks very promising.

Additionally, Dr. Mark Sanborn, in the department of botany and microbiology, has been undergoing studies using recombinant-derived lipopolysaccharides from *Brucella abortus* as a potential subunit vaccine. Again, I will let my written testimony describe the details of his work.

In conclusion, I would say in the last 5, 6 years, scientists nationwide have made great strides in enhancing our abilities to diagnose brucellosis, in increasing our understanding of immunity to brucellosis, and in developing an efficacious nonliving vaccine. It is my opinion that the next 5 years will most likely be characterized by even greater accomplishments in these areas, especially the latter.

It is critical that funding for brucellosis research continue at the present or greater levels to ensure that the results to date can be expanded and research efforts can come to fruition.

I would just like to briefly add a caveat to this. I disagree with testimony from others stating that money is being wasted in nonliving vaccine research. I think, yes, eradication is possible with Strain 19. But as has already been stated, even if we eradicated those known infected herds right now, in class B States new herds that are infected come up periodically.

My feeling is that Strain 19 will become actually the problem as we get closer and closer to eradication. It might be that a nonliving vaccine, which may not be even quite as good as Strain 19 but safer, may be needed in the final phases of eradication, and even in the period following eradication, to ensure that we remain brucellosis free.

So I would add that I believe that this area of research is extremely critical and extremely important to continue.

Thank you very much.

[The prepared statement of Mr. Confer appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Next, Dr. Ocleris Simpson, dean, research and extension, Langston University, Langston, Oklahoma.

STATEMENT OF OCLERIS SIMPSON, DEAN, RESEARCH AND EXTENSION, LANGSTON UNIVERSITY, ACCOMPANIED BY MICHAEL POTCHOIBA, PING WU, A.D. SCARFE, TILAHUN SAHLU AND DURANT IVEY

Mr. SIMPSON. Mr. Chairman, I am Ocleris Simpson, dean for research and extension, Langston University, and I am the acting director of the American Institute for Good Research.

In order that your questions may be answered today, I have with me Michael Potchoiba, Tilahun Sahlu, Ping Wu, and Durant Ivey from the institute.

Mr. Chairman, we would like to thank you for this opportunity to be able to appear before your subcommittee. I would like to indicate also that in the interest of time we have submitted a fairly comprehensive testimony for the record. So I would just like to briefly go to the central theme of my testimony.

And that is based on the fact that we speak for the poor man's cow, which is the goat. As late as 30 days ago we were reluctant to even bring up the subject of brucellosis in goats because there is a social problem among some of the consumers of goat milk. They feel like pasteurization should not be involved because for some reason or other they think this will interfere with its libido properties. So, consequently, they do not want any part of this. However, during the past 30 days, with the concerns expressed by AMPHI, the Texas and Southwestern Cattlemen's Associations, we thought we should step forward and let you know that goats indeed do contract brucellosis, even though the incidence is very low or virtually zero in the United States at this time.

Also, impacting our desire to appear here today was a request received from Egypt to give some assistance with the brucellosis problem there with goats. When I say goats, we are really talking about *Brucella melitensis* instead of *abortus*. Everything you have heard this morning pretty well focuses on *abortus*, and we are talking about *melitensis*. This is the one that kills you, it kills humans.

The concern is not so much in terms of the loss to the industry from the loss of animals; it is the loss of people that we are concerned about. And, consequently, we think that perhaps some type of surveillance should at least be planned or thought should be given to developing some type of surveillance to assure the safety of the food chain with respect to goat milk products put into place. How far one should go with that, at this point in time, would depend on how far one is willing to go with protecting the food chain.

It is kind of like growing corn. If you want it to grow this tall, you put in a little fertilizer. If you want it to grow real tall, you put on a little more.

Anyway, that is our concern and our institute does have the potential for carrying out such a surveillance. So with that, and again in the interest of time, Mr. Chairman, I thank you for the opportunity to appear and to make this fact known. And should it be necessary to amend our written testimony in the record, we will do that.

[The prepared statement of Mr. Simpson appears at the conclusion of the hearing.]

Mr. STENHOLM. Mr. Watkins.

Mr. WATKINS. It is very interesting and I would like to say, Dr. Alexander, I appreciate your leadership and the leadership of the college and the attitude about being involved in brucellosis research and also technology transfer that I think leads to a lot of preventive opportunity or educational effort being made in areas where we have had some hot counties or infected herds. So I want to salute you for that leadership.

Let me say I also agree that I think a kill vaccine would be worthwhile, or the synthetic. If you get down to herds eradicated, maybe we can do some things on the preventive, or to keep it at a normal stage. I think that is very, very crucial.

And I was quite intrigued about the goat research. Mr. (Kika) de la Garza is a fan of yours in the research, and I can see in a lot of the Third World developing countries where we have some real tragic situations that just could not research out across the world to try to help some problems, not only brucellosis, but in other areas.

I just wanted to make those comments. No particular questions. But thank you very much for what you are doing.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. Mr. Chairman, I have no questions.

But, Dr. Simpson, I would just like to acknowledge that we are aware of the International Research Institute and the work that you are doing. I have just perused your testimony and in the first few paragraphs I sensed something, a little different direction, and I can assure you that the staff and the committee will go over it. And if there are questions, we certainly will submit questions in writing.

Mr. SIMPSON. Thank you.

Mr. STANGELAND. We appreciate your being here very much.

Mr. STENHOLM. I might add that since Chairman de la Garza has taken a specific interest in the goat industry, I think it would be the understatement of the day to say that this subcommittee will not take special interest in the problems which you are talking about.

Mr. SIMPSON. We appreciate it.

Mr. STENHOLM. We are very aware of some of the social implications of this. But at the same time it fits within the overall picture of the subject we are discussing and we appreciate your willingness to testify.

Unfortunately, we are out of time and I will postpone any questions that we have. All of your testimony will be made a part of the written record, and we appreciate your being here very much. Thank you all.

The final panel: Mr. Jimmy Owen, Mr. Randy Ward, and Mr. Bill Bugg.

First, Mr. Jimmy Owen, first vice president, Texas and Southwestern Cattle Raisers Association, Tyler, Texas.

Mr. Owen.

STATEMENT OF JAMES B. OWEN, FIRST VICE PRESIDENT, TEXAS
AND SOUTHWESTERN CATTLE RAISERS ASSOCIATION

Mr. OWEN. Thank you, sir.

Chairman Stenholm, Congressman Watkins, Congressman Stangeland, fellow panelists, and guests. My name is Jimmy Owen. I am pleased to be before this subcommittee today as first vice president of the Texas and Southwestern Cattle Raisers Association. We are a 112-year-old trade association with approximately 14,000 members mostly in Texas and Oklahoma.

Texas cattlemen thank you for convening this oversight hearing on the brucellosis program. You have assembled a group of people recognized for their knowledge of this program. You have given us an opportunity to speak our piece—to set in motion a rapid acceleration of this program—to eradicate this costly disease from cattle herds of these two great States and, indeed, the Nation. For that we thank you.

My brief remarks today are shaped by my firsthand knowledge of the disease and the program. My experience has been developed over a lifetime in the cattle business. I am a commercial cow/calf producer in east Texas, in the Tyler area, and at one time I had cattle that were infected with brucellosis, so I have firsthand knowledge of both the disease and the program. I also run stocker cattle and feed cattle in a commercial feedyard. In addition, I serve as vice chairman of the Texas Animal Health Commission.

With this background, I would like to share with you my views on the brucellosis program. I have four points to make and then I will try to answer any questions.

First, the brucellosis program in Texas has made tremendous strides toward eradication and control in recent years. Since 1979, Texas has made its most substantial progress in brucellosis eradication.

During this decade of progress, we have used our eradication funds to increase adjacent testing, acquire the most reliable laboratory equipment, improve the quality and efficiency of our staff, and make significant technological advances in our battle against the disease.

The statistics which Dr. Holcombe has already presented are concrete evidence of this progress, so I will not dwell on this point.

Second, Texas cattle producers, for the most part, are cooperative and have a good attitude about the brucellosis program. There is significant evidence among the cattle producers of Texas that they realize the importance of the eradication of brucellosis in our State if we are to continue to move our cattle freely. It is my opinion they are ready to move ahead and finish the job.

Tangible evidence of this is seen in the fact that Texas now has more than 2,200 certified-free herds. These herd owners test all their cattle once a year at their own expense, even though they have no known disease, just to make certain they are selling clean cattle.

Let me quote from a letter I recently received from one of our members. While this man is writing primarily in support of mandatory vaccination, I think it demonstrates the attitude of Texas cattlemen about moving the program forward.

Now, what has happened to our mandatory calfhood vaccination for all females in Texas? It is time that we try again. We cannot, you cannot afford to let Texas be quarantined; not even the eastern third. Let's get mandatory calfhood vaccination back in place now. Why not this October 1989?

If inconsistent rules and regulations are a part of our undoing, then let's get consistent.

Third, a cut in Federal funding for the brucellosis program in Texas could wipe out much of the progress made in recent years. In fiscal year 1989, in spite of substantial progress made in the State and the impending October 1990 deadline for all States to reach class A status, deep Federal funding cuts were made in the brucellosis eradication program.

They could not have come at a more inopportune time and have made it increasingly difficult for Texas to maintain its progress. If this funding is not restored to at least the 1988 level, it is my opinion it will be very difficult for us to continue our progress at the present rate.

My fourth and final point. Texas cattlemen want congressional support for an accelerated rapid reduction plan to eradicate brucellosis. I have attached to my written comments a copy of the rapid reduction plan which has the support of both the Texas and Southwestern Cattle Raisers Association and the National Cattlemen's Association.

I will not take the time to cover the details of this program today, but I would like to briefly summarize it.

The plan calls for, among other things, an increased use of depopulation, increased adjacent and contact herd testing, mandatory whole-herd vaccination for known infected herds and increased training in high-incident states. This plan is designed to achieve free status for all States within 5 years. I believe this is a viable and achievable goal.

In order to implement this plan, it will require increased funding, particularly in the next 3 years, but I think a close examination of the plan will show that it is the most effective way to proceed.

I strongly urge that you give the funding of this program very serious consideration.

Let me review the four points that I want to make: One, brucellosis program in Texas has made tremendous stride for eradication and control in recent years.

Two, Texas cattle producers, for the most part, are cooperative and have a good attitude about the brucellosis program.

Three, a cut in Federal funding for the brucellosis program in Texas could wipe out much of the progress in recent years.

Four, Texas cattlemen want congressional support for the accelerated rapid reduction plan to eradicate brucellosis.

On behalf of Texas and Southwestern Cattle Raisers Association, I want to thank you for the opportunity to present our views today. And I will be glad to try to answer any questions.

Thank you, sir.

[The prepared statement of Mr. Owen appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you, Jimmy.

Next, Mr. Randy Ward, president, Oklahoma Cattlemen's Association.

**STATEMENT OF RANDY WARD, PRESIDENT, OKLAHOMA
CATTLEMEN'S ASSOCIATION**

Mr. WARD. Chairman Stenholm, and distinguished subcommittee, I am Randy Ward, president of the Oklahoma Cattlemen's Association.

Brucellosis has been a costly disease over the years to the cattle industry, both in losses of production and tax dollars spent on control.

Oklahoma cattlemen have deep concerns about the brucellosis program and the funding necessary to complete eradication. Many of the tools we have used in the fight against brucellosis have worked well for us. Some of the examples are mandatory vaccination and adult vaccination to name a few.

Approximately 4 to 5 years ago I came to the conclusion that brucellosis would be nearly impossible to eliminate. However, today there are fewer cases of the disease in Oklahoma than any time I can remember. I think all segments of the industry can now see an end in sight for this disease.

Oklahoma plays an important role in the Nation's food chain as one of the larger beef-producing States. Over 44 States have achieved brucellosis-free status, but presently Oklahoma is not one of them. Our State is not only a producer but is also an exporter and importer of beef to other States.

We import cattle from southeast of Oklahoma were infection incidents are higher and we export to northern and western States that are disease-free. You can see our problem of the disease-free States not wishing to risk reinfection by taking our cattle.

Our cattlemen need the supply of cattle from the Southeast. Free movement of cattle must continue. Without a doubt, the eradication program must be carried out. The heavy dollars have been spent and the end is in sight. Should efforts against this disease be slowed or terminated at this point, reinfection will occur causing disruptions in the supply of beef and great hardship on the Oklahoma and the national cattle industry.

The Governor of Oklahoma has appointed a brucellosis study committee to speed up the bangs-free program for Oklahoma. Several gentlemen here today serve on this committee. I have been impressed with the harmony of this committee with all segments of the cattle industry working together toward one goal and unanimously agreeing on a bangs-free Oklahoma.

This committee feels that the USDA's rapid reduction plan of mandatory depopulation and/or whole-herd vaccination along with adequate funding will delivery the knock-out blow to brucellosis in Oklahoma.

I ask you to make every effort to help make funds available to totally eradicate this disease.

Chairman Stenholm and distinguished subcommittee, thank you for holding this hearing here in Stillwater, Oklahoma.

[The prepared statement of Mr. Ward appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Mr. Bill Bugg, southern region board member, Associated Milk Producers, Inc.

STATEMENT OF WILLIAM E. BUGG, DIRECTOR, ASSOCIATED MILK PRODUCERS, INC.

Mr. BUGG. Mr. Chairman, I am Bill Bugg, a dairyman from Hennessey, Oklahoma. My wife and I operate a family dairy farm, raising purebred Holstein cattle and producing grain and alfalfa. In addition to my farming operation, I am a director of Associated Milk Producers, serve on the board of directors of the World Dairy Expo, the Oklahoma Dairy Herd Improvement Association, the Oklahoma Holstein Association, and serve on the National Dairy Promotion and Research Board.

I appreciate the opportunity to comment on the need for adequate funding to implement the rapid reduction plan for brucellosis eradication. After years of effort, a good deal of trial and error, we are approaching a point where elimination of this disease as a threat to human and animal health is in sight.

Today, there are fewer than 2,000 herds in the United States infected with brucellosis. Many States have been classed as free of the disease. The challenge is to move forward with actions that will extend this status to all States.

The progress made over the past 10 years is an outstanding example of what can be done through cooperative efforts in all sections of the industry, State, and Federal Government. Ten years ago we were losing ground in the fight against brucellosis. There was a great deal of disagreement within the livestock industry and between the industry and government as to how to deal with the problem. Many even questioned the idea of eradication.

The work of the National Brucellosis Technical Commission was the starting point of the turnaround. Steady progress has been made in implementing the Commission's recommendations and we are now, so to speak, in the home stretch. A plan designed jointly by the industry and government has outlined a 5-year program that will place us in the position where all States would be brucellosis free or in the process of being elevated to that classification by the end of that time.

This would remove a constant source of concern for me as a dairyman. It would eliminate a public health hazard which once was among the worst facing the Nation. It would complete long years of effort to reach this goal.

There comes a time when the goal line is within reach, and with an all-out effort we have that opportunity to win the battle against brucellosis.

I urge Congress to extend the necessary support to these efforts, included the needed funds so that the work will progress on schedule.

Thank you.

[The prepared statement of Mr. Bugg appears at the conclusion of the hearing.]

Mr. STENHOLM. I believe we will go ahead and question the three of you at this time.

Mr. Watkins.

Mr. WATKINS. I just have one quick question.

You all were out on the firing line in the practical phase of this whole thing, and I very much value your testimony.

Randell, hearing Dr. Hartin talk about October 1990, it is going to start costing us millions of dollars. Do you feel that we are on schedule? Do you think this might get solved between now and then so it would not hit us so hard?

Mr. WARD. Well, Congressman, I feel like at this point that we have to speed it up a little bit, and I think we are doing everything we can do to that at this point. And I think Dr. Hartin will probably back me up on that. We may have been a little bit behind, but I think we are probably catching up. And I think we are making an all-out effort, and we realize the dollars that it could cost our industry here in this State.

And not only our State, but we like to buy a lot of cattle out of my friend's country right here and bring them up here and make a few bucks off of them. He has to get his deals together, and we have got to get our deals together, and the other people have to make it.

And then it will warm up and we will be ready to go. [Laughter.]

Mr. WATKINS. I have not made any dollars off the Texans yet.

Mr. WARD. Why old Jim and I make dollars off of each other all the time.

Mr. WATKINS. Just keep trying. But I think the dairy industry has been more advanced by far. They have more control of the situation than what we have in ours, so I recognize that. But that is going to be a serious timetable that we are on up here.

Mr. WARD. Yes, absolutely.

Mr. WATKINS. That is all I have at this point.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. I do not really have a question, Mr. Chairman. But I would just thank this panel and the previous panel. This has been an excellent hearing, and I know we are going to hear more, but I think I want to leave you with this thought, and I think I express this for the other members and the members of the Agriculture Committee in Washington.

We sure hope we can keep to that 5-year timeframe. And I would say we are so close to the goal line, we ought to make sure we keep to it, except we have a budget deficit problem, and we are going to have to work within the constraints of that budget. But this is so important and we are so close, we do not want to string it out any longer. And we will do everything we can.

I know Wes is going to be hammering for that money in the Appropriations Committee. I will be there trying to help him out.

Thank you, Mr. Chairman.

Mr. STENHOLM. Yes, I would just underline that. We do have a major budget problem in the United States. However, we have very worthwhile projects and programs that we want to see funded.

I guess one question that I would have of you, Jimmy, is where you say "Texas cattle producers, for the most part," could you define "for the most part" more carefully?

Mr. OWEN. Sure. The brucellosis program is not popular with anybody. When you have brucellosis, you have a problem. And

none of us—I did not like to clean mine up, and the best producer does not like to clean it up. It is expensive for him and for the State, so it is a problem.

But producers who are in the business seriously, I think, recognize that if Texas cattle, as I have said, are going to continue to move, we have to clean up brucellosis. But there are certain people in the industry who—it does not make any difference whether their cattle have Brucellosis or not.

If I buy today and sell tomorrow, it does not make any difference to me whether the cow has brucellosis. All I am interested in is making \$50 a head or \$25 a head profit. Those kind of people are business people. This is a business decision as far as they are concerned.

So there are some of those people. I think they are basically short-sighted, but are not really interested in cooperating. What they want to do is just get the program over with. Those are primarily the people that are still not sold on the program in Texas.

That is the reason I say for the most part. There will always be a few that cannot see the wisdom of cleaning this thing up and have been against it forever, and they will probably still be against it the day it is cleaned up. But those are the people which I kind of left the door a little bit open.

Mr. STENHOLM. Thank you very much, Jimmy.

Our last two witnesses now, Mr. John McCroskey and Mr. Kenneth Sherrill.

John McCroskey, southern region board member, Associated Milk Producers, Inc.

STATEMENT OF JOHN L. McCROSKEY, MEMBER, BOARD OF DIRECTORS, SOUTHERN REGION ASSOCIATED MILK PRODUCERS, INC.

Mr. McCROSKEY. Mr. Chairman, I am John McCroskey. I am a dairy farmer from the Stillwater area. I have been active in the dairy industry for all of my career, and currently serve on the southern region board of AMPI, and am on the board of the Oklahoma Division of AMPI. I am currently president of the Oklahoma DHI, State board.

I appreciate your interest in and concern over the need to finally defeat this disease that has been a constant problem and concern to dairymen and a threat to the public health of this State. The rapid reduction plan for brucellosis eradication will, if fully implemented, provide the tools to effectively eliminate the disease within 5 years.

We have reached this point because of the willingness of farmers and ranchers to work together with the Government in the development of a program that will work. Just as important, we are at this point, because of the leadership of Congressmen like Wes Watkins, who have taken a lead in assuring adequate funding for the program and then following up to assure that the program has been effectively implemented.

The rapid reduction plan would concentrate added resources on identification of the remaining points of infection, herd depopulation where needed to remove the reactors and prevent the spread

of the disease, and vaccination to prevent spread and reinfection. To carry out the plan within the 5-year timeframe means an increase in all of the major areas of activity: Testing, depopulation, and vaccination.

There have been instances in the past when we have lost ground in the fight to eliminate brucellosis when efforts were relaxed due to budget or to personnel limitations. These have, in the long run, cost us more and made the task more difficult. This is a mistake that must be avoided. We must use the present opportunity to write a successful conclusion to this long and difficult battle. A wide range of individuals and organizations representing dairy and beef producers have endorsed the rapid reduction plan and urge its full implementation. I also join in this request and hope that we can continue this program and support it to the best of our ability.

Thank you.

[The prepared statement of Mr. McCroskey appears at the conclusion of the hearing.]

Mr. STENHOLM. Next is Mr. Kenneth Sherrill, owner-manager, McAlester Union Livestock Marketing, McAlester, Oklahoma.

**STATEMENT OF KENNETH W. SHERRILL, OWNER AND MANAGER,
McALESTER UNION LIVESTOCK MARKETING, INC.**

Mr. SHERRILL. Thank you. I am Kenneth Sherrill, owner and operator of the McAlester Livestock Yard. I am also a member of the LMA marketing sector, and that organization represents 1,300 markets in Oklahoma as well as Canada and the rest of the United States.

I am not going to talk too much about what I have already handed you in my written statement, but would just like to reiterate and back-up a lot that has been said here today in that the marketing sector as well as myself is in favor of the rapid reduction plan.

If anything else I have learned here today, it is—you do not want to use for the most part, do you, Sonny, in your statement because I do not want to have to get into defending Oklahoma like you had to defend Texas. [Laughter.]

But Oklahoma does not have these problems and Texas and Arkansas and these other States do. [Laughter.]

We ask that members of this subcommittee take it back to the congressional hearing that this is not a time to take the funds away from the program. It is time to get right in the middle of it and go at it like a biting dog, and spend the money when the time is needed.

You spoke earlier of the fact that you have a budget problem in the United States, and it does not surprise me any that we do. We spend money in a lot of instances helping foreign lands that we could spend the money here at home and do a better job with it. This is a problem that does not need to be laxed up on at this present time.

Some 40 years we have worked to get out of this program. Unless you are lucky, you got banged early and got out with \$88. There are a lot of us that are still in this thing, and we are fighting to get rid of it.

I appreciate the fact that you gentlemen held this hearing today. I think there has been a lot of valuable testimony here today. And as far as the marketing sector is concerned, and myself, we backup what has been said.

Other than that, you have my written statement, and to save time I will try to answer any questions that I can.

[The prepared statement of Mr. Sherrill appears at the conclusion of the hearing.]

Mr. STENHOLM. Thank you.

Mr. Watkins.

Mr. WATKINS. Let me say this to both of you. I appreciate your bringing your views here because you people are out there trying to make it work as cattlemen and marketers.

Kenny, I know you and I have sat and talked about this problem a great deal. I think we know what we are faced with.

I would just like to say that we have tight budgets. If you have not been to one of those Appropriations Committee meetings, we put an additional \$6 million even in tight budgets to try to get this rapid reduction plan. We think we will come out somewhere close to that. I will know Monday afternoon probably. But we are hoping we can keep it there because we share with you that we have to try to wrap this thing up in a matter of a few short years, and we have to get our house in order before October 1990 so maybe we can save the cattlemen a lot of money.

Kenny, I appreciate very much, I know you are down in an area that has concern and problems and that we have been able to face it professionally and try to solve it.

Mr. SHERRILL. Well, we do not need to come to the place where we pull the funds away from the program at this time. It is time to go full ahead. I think something was said by Randy Ward, our Cattlemen Association president, is that needs to be taken into full light. We are crossing grounds. Oklahoma is a lot of crossing grounds for a lot of cattle headed to the North. And we do try to bring them in here and make money off of them, Sonny. But at the same time we have to keep them moving North, and our moving cattle out of Oklahoma is our salvation, so to speak. And anything that would harmfully keep that from happening would be real detrimental to this economy in Oklahoma.

As you well know, Oklahoma has been known for its oil, but Oklahoma is an agricultural State.

Mr. STENHOLM. Mr. Stangeland.

Mr. STANGELAND. I have no further questions, except again to reiterate. I think you have had an excellent hearing today, Mr. Chairman, some excellent testimony, and certainly we go back to Washington with a good deal of ammunition to make sure that we complete the 5-year plan on time. Thank you.

Mr. STENHOLM. My only comment is that it is always helpful when agriculture is unified. When dairymen, cattle producers, livestock marketing associations, and everyone is behind a program, the chances of us accomplishing that which you asked us to do is always improved dramatically. And that is a point that has not escaped me in this area.

We thank all the witness today.

Again, Wes, thank you very much for your work in putting this hearing together, because it is extremely timely.

Mr. THOMPSON. May I ask a question?

Mr. STENHOLM. You surely can. Identify yourself for the record.

Mr. THOMPSON. Jim Thompson.

The eradication plan that includes whole-herd vaccination or mandatory depletion, is that right?

Mr. STENHOLM. Yes.

Mr. THOMPSON. And/or.

Is that similar to a whole-herd buyout? [Laughter.]

Mr. STENHOLM. I do not believe so. This public hearing is adjourned.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned, subject to the call of the Chair.]

[Material submitted for inclusion in the record follows:]

TESTIMONY OF DR. BILLY JOHNSON
ASSOCIATE DEPUTY ADMINISTRATOR, VETERINARY SERVICES
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
BEFORE THE SUBCOMMITTEE ON
LIVESTOCK, DAIRY AND POULTRY,
HOUSE COMMITTEE ON AGRICULTURE
ON TECHNOLOGICAL ADVANCEMENTS AND OTHER
MEASURES LEADING TO ERADICATION OF BRUCELLOSIS--
PAST, PRESENT, AND FUTURE

SEPTEMBER 23, 1989

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE, I AM PLEASED TO BE HERE IN STILLWATER TO DISCUSS THE HISTORY AND STATUS OF THE BRUCELLOSIS ERADICATION PROGRAM AS WELL AS OPTIONS FOR THE FUTURE DIRECTION OF THE PROGRAM. IT HAS BEEN A LONG AND SOMETIMES DIFFICULT TASK, BUT WE HAVE LEARNED MUCH AND MADE GREAT PROGRESS IN THE ERADICATION OF THIS REPRODUCTIVE DISEASE THAT CAN BE SO HARMFUL TO LIVESTOCK, TO PUBLIC HEALTH, AND TO INTERSTATE AND INTERNATIONAL COMMERCE.

THE FIRST EFFORTS TO CONTROL BRUCELLOSIS WERE CARRIED OUT BY THE STATES IN THE 1920's. UNFORTUNATELY, LITTLE PROGRESS WAS MADE AND IT BECAME CLEAR THAT A COORDINATED APPROACH WAS NEEDED. IN 1934, THE STATE-FEDERAL COOPERATIVE BRUCELLOSIS ERADICATION PROGRAM WAS LAUNCHED ON A NATIONAL SCALE UNDER THE AUTHORITY OF PUBLIC LAW 142. INITIALLY, THE PROGRAM WAS PART OF A PROJECT TO REDUCE THE NUMBER OF CATTLE IN THE UNITED STATES BECAUSE OF DROUGHT CONDITIONS. THE GOAL WAS TO REDUCE THE NUMBER OF CATTLE BY ELIMINATING

DISEASED ANIMALS. ANIMALS WERE GIVEN BLOOD TESTS, INFECTED ANIMALS WERE REMOVED FROM THE HERD, AND AN INDEMNITY WAS PAID. THE RATE OF REACTORS IN THE TESTED POPULATION OF ADULT ANIMALS WAS 11.5 PERCENT. BY 1937, THE REACTOR RATE AMONG TESTED CATTLE HAD DECREASED TO 5 PERCENT.

BETWEEN 1939 AND 1942, MUCH PROGRESS WAS MADE IN THE PROGRAM. TEST RESULTS BECAME MORE CONSISTENT WHEN THE BUREAU OF ANIMAL INDUSTRY, THE PREDECESSOR OF THE ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS), BEGAN SUPPLYING STATES WITH A STANDARDIZED ANTIGEN TO USE IN TESTING CATTLE. SHORTLY AFTER THAT, THE BRUCELLA ABORTUS STRAIN 19 VACCINE WAS ADOPTED AS AN OFFICIAL PART OF THE PROGRAM. PROGRESS WAS ALSO REFLECTED IN THE FACT THAT 209 COUNTIES IN 17 STATES WERE DECLARED MODIFIED CERTIFIED BECAUSE OF REDUCED INFECTION RATES. UNDER THE PREVIOUS CLASSIFICATION SYSTEM, MODIFIED CERTIFIED STATUS MEANT THAT LESS THAN 5 PERCENT OF HERDS AND LESS THAN 1 PERCENT OF CATTLE HAD BRUCELLOSIS IN A GIVEN LOCATION. IN 1942, NORTH CAROLINA BECAME THE FIRST STATE TO QUALIFY FOR MODIFIED CERTIFIED STATUS.

THE DEMANDS OF THE WAR YEARS FORCED THE COUNTRY TO FOCUS ITS ATTENTION AND RESOURCES TOWARD THE WAR EFFORT. PROGRAMS SUCH AS BRUCELLOSIS NATURALLY TOOK A BACK SEAT TO THE GREAT PROBLEMS OF THE TIME. UNDER THE CIRCUMSTANCES, MOMENTUM WAS LOST AND, IN FACT, THE REACTOR RATE REACHED 5 PERCENT AGAIN IN 1946 AFTER REACHING A LOW OF 2.6 PERCENT IN 1941.

IN 1947, THE UNITED STATES LIVESTOCK SANITARY ASSOCIATION (USLSA), WHICH LATER BECAME THE UNITED STATES ANIMAL HEALTH ASSOCIATION, RECOMMENDED THE ADOPTION

OF THE FIRST UNIFORM METHODS AND RULES (UM&R) FOR THE ERADICATION OF BRUCellosIS ON A HERD, AREA, STATE, AND NATIONAL BASIS. THE UM&R, FOR THE FIRST TIME, APPROACHED BRUCellosIS AS A NATIONAL PROBLEM. IT REMAINS THE FOUNDATION OF THE ERADICATION PROGRAM, AND PROVIDES A FLEXIBLE MECHANISM TO MODIFY THE PROGRAM TO MEET CHANGING NEEDS AND INCORPORATE NEW TECHNOLOGIES.

TWO YEARS AFTER THE UM&R WAS ADOPTED, REPRESENTATIVES OF 27 LEADING FARM, LIVESTOCK, AND OTHER ORGANIZATIONS JOINED TO FORM THE NATIONAL BRUCellosIS COMMITTEE TO PROMOTE, AID, AND ENGAGE IN EDUCATIONAL ACTIVITIES; ENCOURAGE RESEARCH; AND COORDINATE THE ERADICATION EFFORT.

THE 1950'S SAW AN ACCELERATION OF THE PROGRAM AND IMPROVEMENTS IN AVAILABLE TECHNOLOGY, INCLUDING ADOPTION OF THE MILK RING TEST (BRT) TO ALLOW FREQUENT SCREENING OF DAIRY HERDS AT A LOW COST AND THE DEVELOPMENT OF AN ACIDIFIED PLATE ANTIGEN TEST FOR DIFFERENTIATING NONSPECIFIC REACTIONS. IMPROVEMENTS IN THE TECHNOLOGY WERE ACCOMPANIED BY IMPROVEMENTS IN THE SURVEILLANCE SYSTEM. THE MARKET CATTLE TESTING PROGRAM, IN WHICH CATTLE ARE TESTED AT SLAUGHTER AND CONCENTRATION POINTS, WAS ADOPTED IN 1959, ALLOWING THE PROGRAM TO MOVE AWAY FROM AREA TESTING EFFORTS AND TOWARD TRACING INFECTION TO INDIVIDUAL HERDS. AT THE SAME TIME, ADULT VACCINATION WAS DISCONTINUED BECAUSE THE BLOOD SERUM AGGLUTINATION TITER CAUSED BY THE VACCINE INTERFERED WITH THE TESTING PROCEDURE THEN IN USE.

IN 1960, THE USLSA ESTABLISHED NATIONAL GOALS FOR THE PROGRAM. THE GOALS WERE TO HAVE ALL STATES ACHIEVE MODIFIED CERTIFIED STATUS BY 1965; ALL STATES WERE

TO BE CERTIFIED FREE OF BOVINE BRUCELLOSIS BY 1972; AND ALL STATES WERE TO BE CERTIFIED FREE OF SWINE BRUCELLOSIS BY 1979. UNFORTUNATELY, ALTHOUGH PROGRESS CONTINUED, ACHIEVING THESE GOALS PROVED TOO DIFFICULT. PART OF THE REASON FOR THIS WAS THE DECISION TO DEEMPHASIZE VACCINATION STARTING IN 1967.

IMPROVEMENTS IN TESTING CONTINUED IN 1963 WHEN THE BRUCELLOSIS CARD TEST WAS ADOPTED AS AN OFFICIAL TEST FOR SWINE, ALTHOUGH THE EFFORT AGAINST SWINE BRUCELLOSIS WAS NOT TO BECOME A NATIONAL PROGRAM UNTIL 1972. IN 1966, THE BRUCELLOSIS CARD TEST WAS ADOPTED FOR BOTH CATTLE AND SWINE.

THE GOAL OF ERADICATION WAS SET BACK SOMEWHAT IN THE EARLY 1970'S AS A SERIES OF DISEASE EMERGENCIES, INCLUDING HOG CHOLERA AND EXOTIC NEWCASTLE DISEASE, RESULTED IN A REDIRECTION OF RESOURCES TO MEET THOSE EMERGENCIES. TO STRENGTHEN THE PROGRAM DURING THIS PERIOD, THE UM&R WAS AGAIN REVISED. STRENGTHENING MEASURES, INCLUDING TESTING AT THE FIRST POINT OF CONCENTRATION AND "S" BRANDING OF EXPOSED ANIMALS TO PREVENT DIVERSION TO MARKETS OTHER THAN SLAUGHTER, WERE BEGUN IN HIGH INCIDENCE STATES. IN ADDITION, MORE EMPHASIS WAS PLACED ON RESEARCH AND CALFHOOD VACCINATION. ONCE THE OTHER DISEASE EMERGENCIES WERE UNDER CONTROL, CONGRESS INCREASED FUNDING FOR THE PROGRAM. THE ADDITIONAL FUNDS ALLOWED FOR EXPANSION OF HERD DEPOPULATION, CONTACT HERD TESTING, AND SELECTED AREA TESTING.

IN 1976, ADULT VACCINATION WAS AGAIN ADDED TO THE UM&R AS AN APPROVED PROCEDURE FOR INFECTED HERDS. THIS BECAME POSSIBLE BECAUSE REDUCED DOSAGES WERE USED ALONG WITH SUPPLEMENTAL TESTS TO DIFFERENTIATE INFECTION FROM VACCINE RESPONSES. FIVE YEARS LATER, REDUCED-DOSE CALFHOOD VACCINATION ALSO BECAME PART OF THE PROGRAM.

THE DEPARTMENT APPOINTED A BRUCELLOSIS TECHNICAL COMMISSION IN 1976 TO REVIEW AND EVALUATE THE ERADICATION PROGRAM. THE COMMISSION ISSUED ITS FINAL REPORT IN 1978 INDICATING THAT ERADICATION WAS FEASIBLE THROUGH A COOPERATIVE PROGRAM. THE COMMISSION ALSO MADE SOME SPECIFIC RECOMMENDATIONS, AND THESE LED TO A MAJOR REVISION OF THE UM&R THAT BECAME EFFECTIVE IN MAY 1982. THE REVISION CHANGED BOTH THE CLASSIFICATION SYSTEM AND THE REQUIREMENTS FOR MOVEMENT WITHIN AND BETWEEN AREAS.

UNDER THE NEW CLASSIFICATION SYSTEM THERE ARE FOUR CLASSES OF STATES: CLASS FREE, WITH NO INFECTED HERDS OVER THE PREVIOUS 12 MONTHS; CLASS A, WITH LESS THAN 0.25 PERCENT HERD INFECTION OVER THE PREVIOUS 12 MONTHS; CLASS B WITH LESS THAN 1.5 PERCENT HERD INFECTION OVER THE PREVIOUS 12 MONTHS; AND CLASS C WITH MORE THAN 1.5 PERCENT HERD INFECTION OVER THE PREVIOUS 12 MONTHS.

WE HAVE MADE REMARKABLE PROGRESS IN THE BRUCELLOSIS PROGRAM SINCE THE 1982 REVISIONS TO THE UM&R. WE HAVE SEEN A 60 PERCENT INCREASE IN THE NUMBER OF FREE STATES, AND WE NO LONGER HAVE ANY STATES OR AREAS THAT ARE CLASS C. IN FACT, THE LAST CLASS C AREA IN THE COUNTRY--SOUTHERN FLORIDA--WAS ELEVATED TO CLASS B ONLY 3 MONTHS AGO. ONLY 6 CLASS B STATES AND 17 CLASS A STATES

REMAIN. THE U.S. VIRGIN ISLANDS ARE CLASS FREE AND PUERTO RICO IS CLASS A. CURRENTLY, THE OVERALL INCIDENCE OF BRUCELLOSIS IN THE UNITED STATES IS 0.22 PERCENT.

WE ARE PLEASED WITH THE PROGRESS OF THIS COOPERATIVE EFFORT, AND WE CONTINUE TO LOOK FOR WAYS TO IMPROVE THE PROGRAM. FOR EXAMPLE, WE RECENTLY COMPLETED THE PHASE-OUT OF THE BRUCELLOSIS INFORMATION SYSTEM, A RECORDKEEPING SYSTEM THAT WAS INSTITUTED IN 1981. THIS SYSTEM IS BEING REPLACED BY A MICROCOMPUTER BASED RECORDKEEPING SYSTEM (BRUCELLOSIS RECORDING AND REPORTING SYSTEM) THAT WE EXPECT TO BE FULLY IN PLACE BY THE END OF FISCAL YEAR 1990. WE HAVE RECENTLY ADDED MORE SOPHISTICATED TESTING TECHNIQUES TO THE PROGRAM, INCLUDING THE AUTOMATED PARTICLE CONCENTRATION FLUORESCENCE IMMUNOASSAY (PCFIA) TEST. THE PCFIA TEST IS A HIGHLY AUTOMATED PROCEDURE THAT ALLOWS US TO REDUCE HUMAN ERROR AND GIVES HIGHLY REPRODUCIBLE RESULTS. IN ADDITION, THE TEST IS MORE SPECIFIC THAN THE CARD TEST, ELIMINATING MANY FALSE POSITIVES.

IN 1985, WE ESTABLISHED A PLAN TO DIMINISH THE FEDERAL ROLE IN THE PROGRAM OVER A 5-YEAR PERIOD BEGINNING IN FISCAL YEAR 1986. OUR GOAL WAS TO LET THE STATES TAKE ON INCREASED RESPONSIBILITY FOR ERADICATION WHILE THE FEDERAL ROLE MOVED TOWARD ENFORCEMENT OF INTERSTATE MOVEMENT REGULATIONS, DISEASE SURVEILLANCE, AND RECORDKEEPING. RECENTLY, HOWEVER, THE NATIONAL CATTLEMEN'S ASSOCIATION (NCA) ASKED APHIS TO DEVELOP A PLAN FOR THE RAPID COMPLETION OF BRUCELLOSIS ERADICATION. THE FOUR OPTIONS ADDRESSED IN THE PLAN ARE TO

- (1) CONTINUE ON OUR PRESENT COURSE OF DIMINISHING THE FEDERAL ROLE;
- (2) CONTINUE OPERATIONS AT THE CURRENT LEVEL UNTIL ALL STATES ARE QUALIFIED

FOR CLASS FREE STATUS; (3) ACCELERATE OPERATIONS SOMEWHAT UNTIL ALL STATES ARE QUALIFIED FOR CLASS FREE STATUS; OR (4) ADOPT AN ACCELERATED PROGRAM THAT WOULD ACHIEVE ERADICATION IN 5 YEARS. WE ARE CURRENTLY EVALUATING WHAT DIRECTION THE PROGRAM WILL TAKE IN THE DEVELOPMENT OF THE FY 1991 BUDGET. HOWEVER, WE INTEND TO MOVE FORWARD AS RAPIDLY AS POSSIBLE, WITHIN AVAILABLE RESOURCES, WITH OUR COOPERATORS IN THE STATES AND INDUSTRY TO ENSURE THAT WE PROGRESS TOWARD THE ELIMINATION OF THIS SERIOUS DISEASE.

THAT CONCLUDES MY PREPARED REMARKS, MR. CHAIRMAN. I WILL BE HAPPY TO RESPOND TO ANY QUESTIONS YOU MAY HAVE.

U.S. HOUSE OF REPRESENTATIVES
 COMMITTEE ON AGRICULTURE
 WASHINGTON, D.C. 20513

SUBCOMMITTEE ON LIVESTOCK, DAIRY, AND POULTRY, Public Field Hearing, Noble Research Center Theatre, Oklahoma State University, Stillwater, Oklahoma

SUBJECT: Review of technological advancements and other measures leading to the complete eradication of brucellosis

Mr. Chairman and members of the committee, I am pleased to discuss research work on bovine brucellosis being conducted by Agricultural Research Service at the National Animal Disease Center in Ames, Iowa. Research is in support of the national eradication program and will provide improved technology to facilitate eradication and to keep the U.S. free of brucellosis when eradication has been completed.

The research program on bovine brucellosis at the National Animal Disease Center is directed at four major problems: (1) identification of components of the bacterium that are important in disease and use of these components to develop subunit vaccines and diagnostic reagents, (2) development of a living mutant strain of Brucella abortus with disease-causing genes deleted, (3) perfection of a vaccine-testing protocol that accurately predicts effectiveness of vaccines in cattle in the field, and (4) clarification of the behavior of B. abortus in the cow so that we can more efficiently predict the likelihood of successful vaccination.

Identification of components of bacteria, the major focus of our work, is necessary to identify which pieces are important in causing disease and which evoke a protective response in the cow. Specific components that are identified can be transferred to private and public laboratories for development as subunit vaccines and as diagnostic reagents. Major objectives of this area are (1) to identify components present in field disease that are missing in vaccinated animals (or vice versa) so that we can differentiate field disease and vaccine treatment and (2) to use purified fragments of bacteria to produce a synthetic or "killed" subunit vaccine.

The program includes molecular biology to develop a living mutant bacterium for use in a vaccine. To be successful, several different phases of molecular biology must be perfected. Recombinant DNA technology is required to genetically engineer a mutant strain. Two important steps have been taken this year: (1) an efficient protocol for detection of deletion mutants was developed, and (2) candidate genes have been identified. We are currently perfecting technology to transfer genes (DNA) into Brucella abortus (and to screen these new clones for their deletions). The project will improve the existing live vaccine by developing a safer, diagnostic test-compatible, deletion mutant from it. This provides a fall back option in case our project to develop an effective killed vaccine does not succeed within the time frame of the eradication program. The fact that an effective killed vaccine for a chronic intracellular bacterial infections (such as brucellosis, tuberculosis or salmonellosis) has never been developed, in spite of extensive human and animal health research efforts, emphasizes the need for a fall back option.

Our research on pathogenic and immune mechanisms will provide the knowledge of the disease process and immunity required to develop a subunit vaccine using the appropriate identified bacterial components. Efforts to clarify the disease process in the cow involve the following: (1) how B. abortus grows inside cells to detect enzymes or growth factors that cause bacteria to grow too quickly in the reproductive tract, (2) how the immune system of the cow kills (or fails to kill) the bacterium, (3) persistence of B. abortus in the cow and factors that cause it to grow again after a long period of repression, and (4) what is the mechanism whereby B. abortus can persist in the cow in chronic infection. Knowledge of the pathogenic and immune mechanisms at the level required to develop an effective killed subunit vaccine against this chronic intracellular bacterial infection will have spin-off impact for similar infections in humans and animals. That impact will continue long after brucellosis has been eradicated and could potentially be the major biomedical contribution of our brucellosis research program.

Total ARS Budget: \$3,173,600. This amount includes grants to Texas A&M (\$100,000), Oklahoma State University (\$341,300), and Iowa State University (\$35,000). In-house work is partitioned as follows:

Definition of bacterial components	\$1,137,500 \$317,800 to ISU, OSU, Tx A&M
Genetic engineering	\$804,000 \$158,500 to OSU
Vaccine testing	\$354,100 *In-house cooperation with OSU
Pathogenic and immune mechanisms	\$878,000

I thank this Committee for their support of research on brucellosis and urge that this support be continued.

Norman F. Cheville
Research Leader, Bovine Brucellosis
National Animal Disease Center
USDA-ARS

ROBERT L. HARTIN
REPORT TO
CONGRESSIONAL SUBCOMMITTEE ON
LIVESTOCK, DAIRY AND POULTRY

The Brucellosis eradication program has been going on too long. The knowledge and technology are available to complete the job, and it must be done.

Considerable progress has been made in Oklahoma. Ten years ago we had approximately 600 known affected herds, today we have 138, this is a reduction of 77%. Ten years ago we had over 15,000 known infected animals, or "reactors" per year; last year that number was less than 4,000, a reduction of 75%. This is progress, but it is too slow.

A number of program improvements have been made over the years such as mandatory vaccination, adult vaccination, first point testing, adjacent herd testing out to 1/2 mile, improved epidemiologies, and the addition of the PCFIA test. All of these have been effective in reducing the number of infected herds and the spread within those herds. It is again time to reevaluate and fine tune our program to finish the job at hand.

Our vaccination program, implemented in 1982, has been highly successful in getting large numbers of heifers vaccinated. We were vaccinating about 200,000 per year prior to 1982, and it is now over 750,000 per year, but this has also created additional problems.

Since January 1, this year we have had almost 1400 MCI tracebacks; only 8% of these led us to an infected herd. Most of the remainder of these were due to residual vaccination titers.

Considerable funds and resources have been spent the last few years to develop a vaccine and/or test to differentiate between vaccine titer and field strain infection, it is not available today. If such a vaccine was perfected, it would be three (3) to five (5) years before its impact would be felt in the eradication program, and by then we must be Brucellosis free in all states. Other countries could benefit if a better vaccine was perfected, but it would have little or no effect on the final eradication in the United States. It is my opinion that those resources currently expended in vaccination research could be better used and should be directed into another area that would have a more positive impact on final eradication.

APHIS developed a five year plan to be out of major portions of the eradication program by October 1990 with each state assuming the major responsibilities to finish the job. Now is not the time to back off. All resources that are needed to finish the job must be made available until the last infected animal is eliminated. This is not an individual state problem, it is a national problem. Some 44 states are now declared Brucellosis Free or Class A - these states spent millions of state and federal dollars to get there, but they will not remain free very long if complete eradication is not achieved.

Oklahoma imports approximately 1.5 million cattle each year and we export almost 3 million - this movement is an essential element in the production of beef nationally. Our imports come primarily from the southeastern states where Brucellosis is more prevalent and our exports move mostly north and northwest to the lower incidence states. We should not expect to obtain and maintain "Free" status until those states shipping us their cattle have eliminated all foci of infection; likewise, those states receiving our cattle will be at risk of becoming reinfected until final eradication is realized.

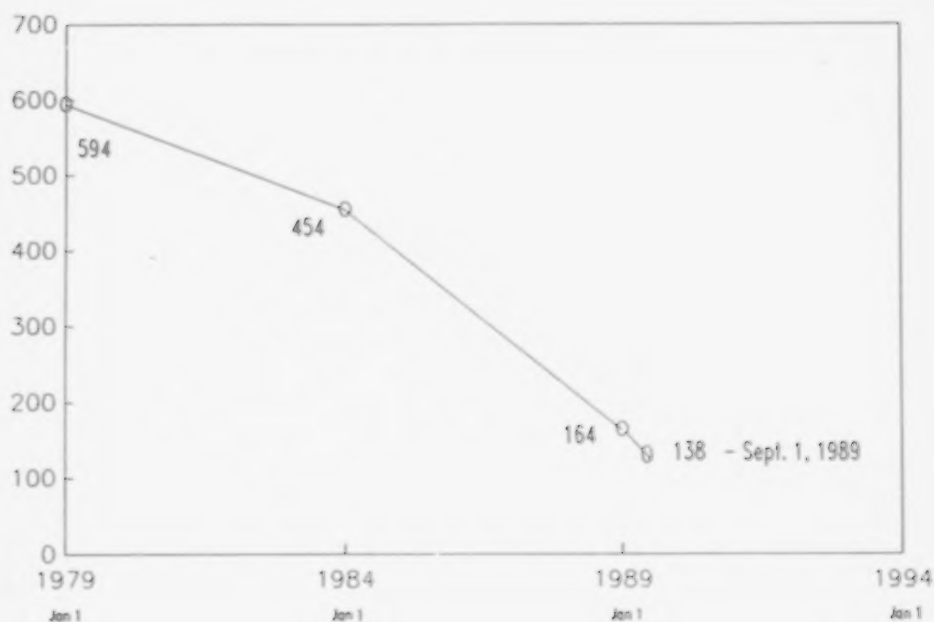
Complete eradication is possible. The tools and technology are available, we must use them. Recently, at the request of the National Cattlemen's Association, USDA formulated a proposal known as the "Rapid Completion Plan." This plan has two major elements: "depopulation" and/or "whole herd vaccination."

Recently, Governor Bellmon appointed a Brucellosis Advisory Committee representing all segments of the livestock industry. This committee is looking at every possible way to accelerate the eradication of Brucellosis in Oklahoma, including the two main elements in the Rapid Completion Plan: mandatory depopulation and/or whole herd vaccination.

Complete eradication is not only possible but it is essential that it be completed. The knowledge, skills and technology are available; but it cannot be done by each state supplying their own resources. It must continue to be a cooperative effort of all states and the federal government. The Rapid Completion Plan has these elements, but the resources need to be made available to carry the plan out. I urge you to give serious consideration to supplying the funds to complete the job. The American cattleman cannot afford to lose what has taken so long to achieve. We are close, let's finish the job.

(Attachments follow:)

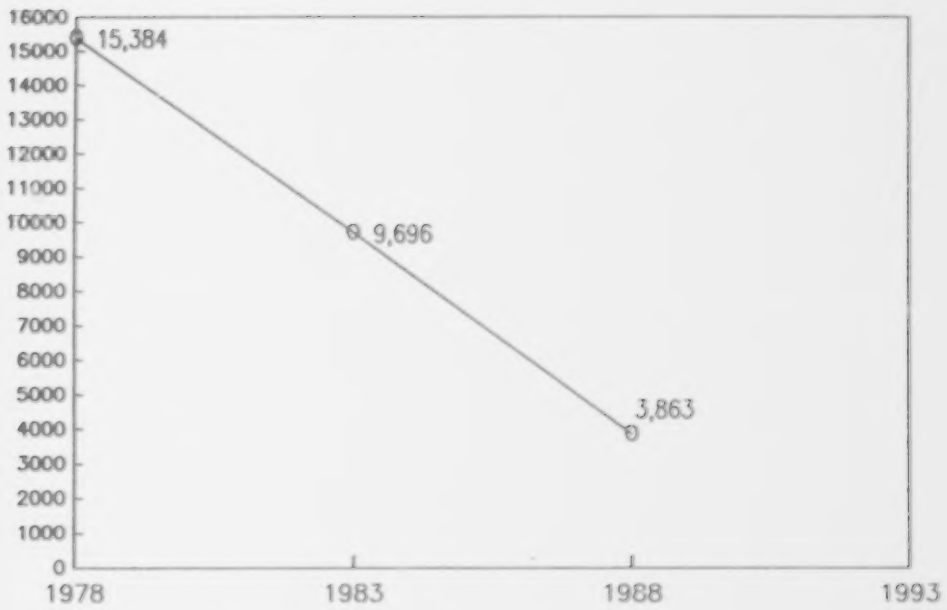
INFECTED HERDS



Reduced 72% in last 10 years

Reduced 64% in last 5 years

REACTORS DISCLOSED



Reduced 75% in last 10 years
Reduced 60% in last 5 years

Texas Animal Health Commission

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Testimony Submitted by:

John W. Holcombe, DVM, Executive Director
Texas Animal Health Commission
210 Barton Springs Road, Austin, Texas 78711

Submitted to

The House Agriculture Subcommittee on
Livestock, Dairy and Poultry

Concerning

"Technological Advancements and Other Measures
Leading to the Complete Eradication
of Brucellosis—the Past, Present and Future."

September 23, 1989

Mr. Chairman, I am pleased to be here to submit testimony concerning the brucellosis eradication program. There is light at the end of the tunnel; we see it for brucellosis eradication, through the Rapid Completion Plan. Nationally, brucellosis eradication has gained momentum and impressive progress is being made.

In 1982, for example, only 13 states were considered to be free of brucellosis. Today, 28 states are rid of the disease, and another 18 have very little infection. In six states, including Texas, concerted eradication efforts are underway to clean up higher rates of infection. This is where efforts must have continued focus.

In Texas, more headway has been made in the last ten years than in all the other decades combined. In fiscal year 1989, 1,113 herds in the state were infected, a dramatic improvement over 1982, when 3,241 herds were quarantined. (See Chart 1, attached.) Today in Texas, 715 herds are currently under quarantine--the lowest number ever. (See Chart 2, attached.)

Stepped-up herd testing and technical improvements in Texas' state/federal laboratories factor into the program's success.

Increased herd testing has resulted in infection being found more often on the ranch, before cattle are moved into commerce. In fiscal year 1989, we found 3,000 fewer infected cattle through livestock market testing than in 1988. This is a 64 percent decrease in one year. (See Charts 3 and 4 attached.)

The drop in infected herds, combined with detecting a higher percentage of infection on-site, are indicators that we are closing in on the last vestiges of this disease.

In Texas' state/federal laboratory, high-technology equipment is used to test the 3 1/2 million samples submitted each year. Particularly valuable is the federally funded PCFIA computerized equipment that provides more accurate test results and is less subject to human error. Use of the PCFIA equipment has cut in half the number of samples traditionally considered to be untestable because of deterioration.

The continued success of the brucellosis program, on a national and state level, depends on three major components. These three components are as important to the program as the three legs on an old-fashioned milking stool.

Anyone who has sat on such a stool knows that, for proper support, each stool leg must be of the same length and strength.

In this analogy, one stool leg represents the federal and state government. Agencies are mandated to conduct testing, quarantine infected herds, work with producers to meet standards, and provide technical assistance.

The second stool leg is the cattle industry, which must undertake equal responsibility for cleaning up and preventing brucellosis. Texas producers during the past 10 years have become more cooperative and positive about the program. Many are instituting management practices to prevent infection, such as having heifers calfhood vaccinated, keeping purchased heifers separate from main herds until they have been retested for brucellosis, and having herds certified brucellosis-free. (See Chart 5, attached.)

The stool's third leg would be the funding for the Rapid Completion Plan. Without a third leg, the stool loses balance and tips over. Without this funding, the brucellosis program loses balance, and regulatory staff and producers would be unable to accomplish eradication objectives in a timely manner.

Funding and a five-year commitment by all parties involved will maintain momentum and bring to a close the national brucellosis eradication program. We are close to finding the last sources of infection. To slow the program now would result in the disease being reintroduced in clean areas. Where brucellosis still exists, it would take a stronger hold.

With Rapid Completion Plan funding, regulatory agencies could offer producers a choice: have the adult cattle in infected herds vaccinated, or depopulate the herd, a move that would accelerate the eradication program.

Depopulation funds have never been used in Texas. But they could be beneficial, especially in small herds, or when owners don't want to go through the frequent testing process, or when they refuse to have cattle adult vaccinated.

Approval of the Rapid Completion Plan would support needed technical reviews. In-depth epidemiological studies would be conducted in counties, or sections of counties, where a high incidence of infection exists that has not responded to usual eradication measures.

Historically, our country has proven its ability and dedication to the eradication of disease. We have succeeded in wiping out hog cholera, in stopping foot and mouth disease, and in putting an end to the huge livestock losses cause by the screwworm.

Even today, we still guard our borders against these diseases to protect against reinfection.

It is just as important that we have the same dedication to wiping out brucellosis--a disease which still exists within our own borders, and which threatens to spread once again, if we do not take action now. The Rapid Completion Plan is well-considered, is feasible and has the backing of industry. With this plan, we can reach that light at the end of the tunnel for brucellosis eradication.

Accumulative Number of Infected Herds

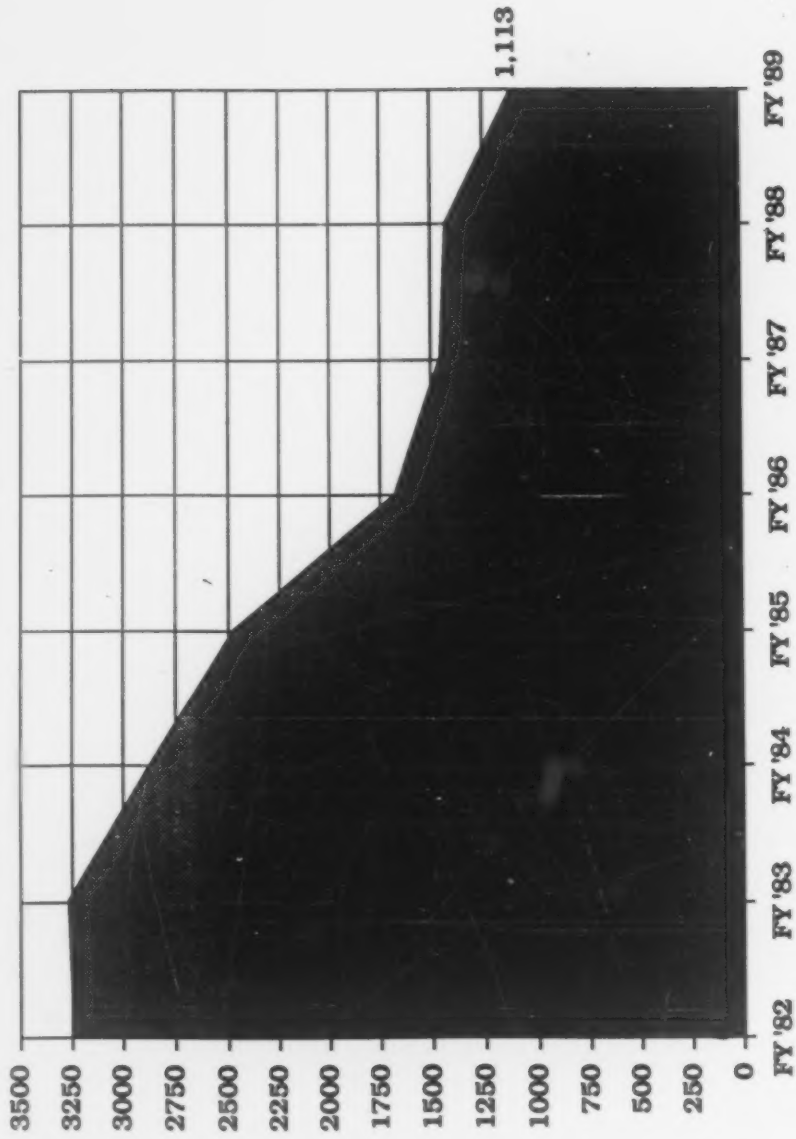
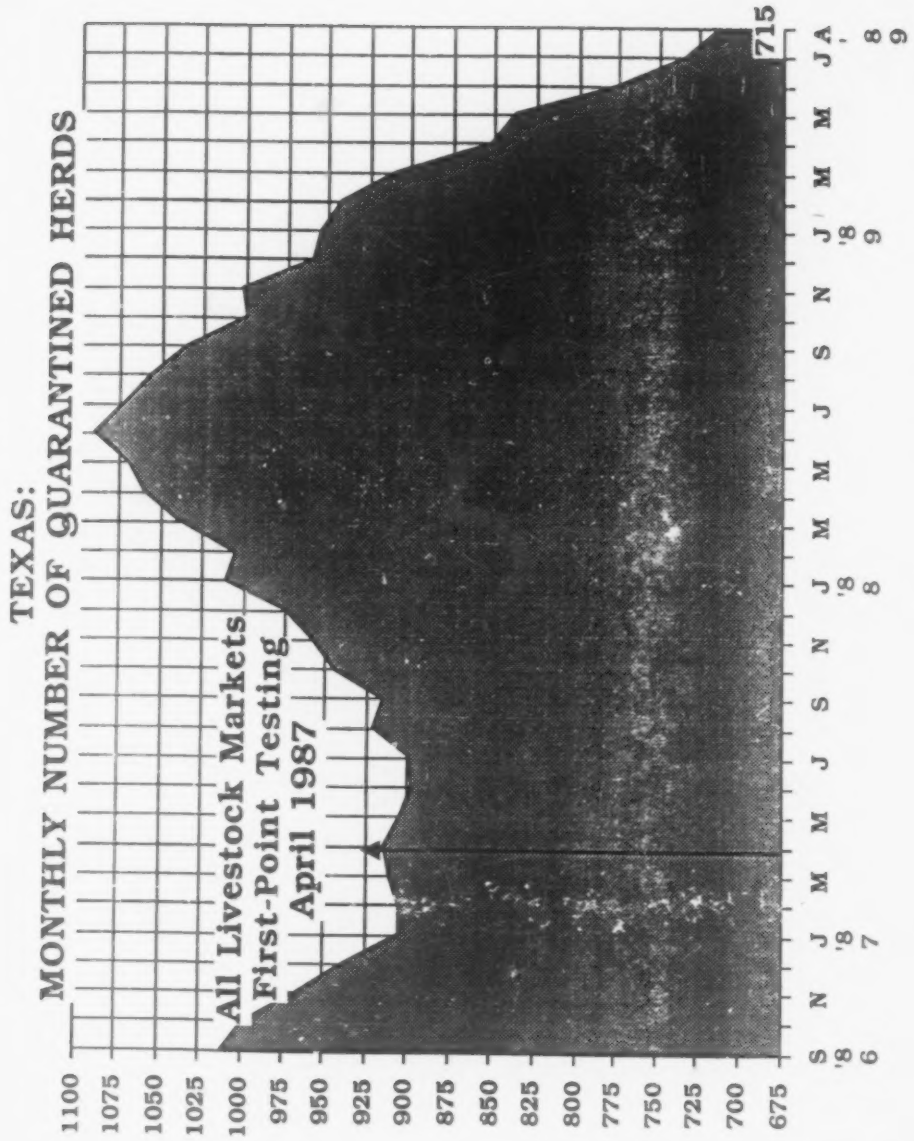


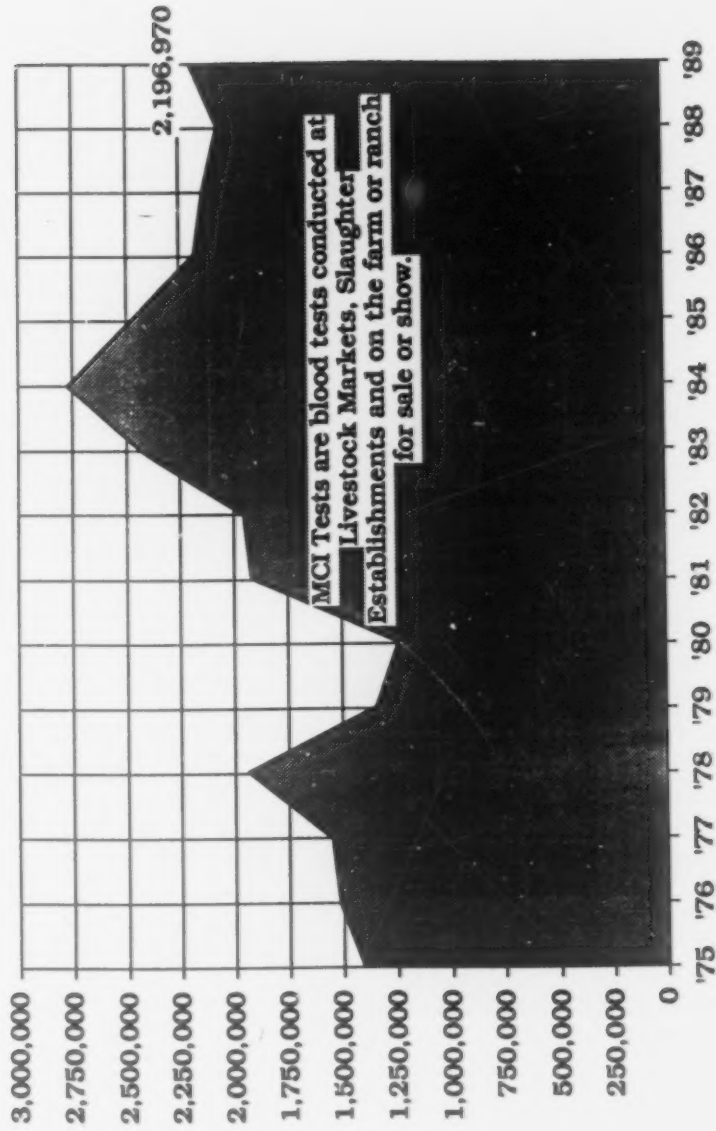
Chart 1

Produced by TAHC

Chart 2



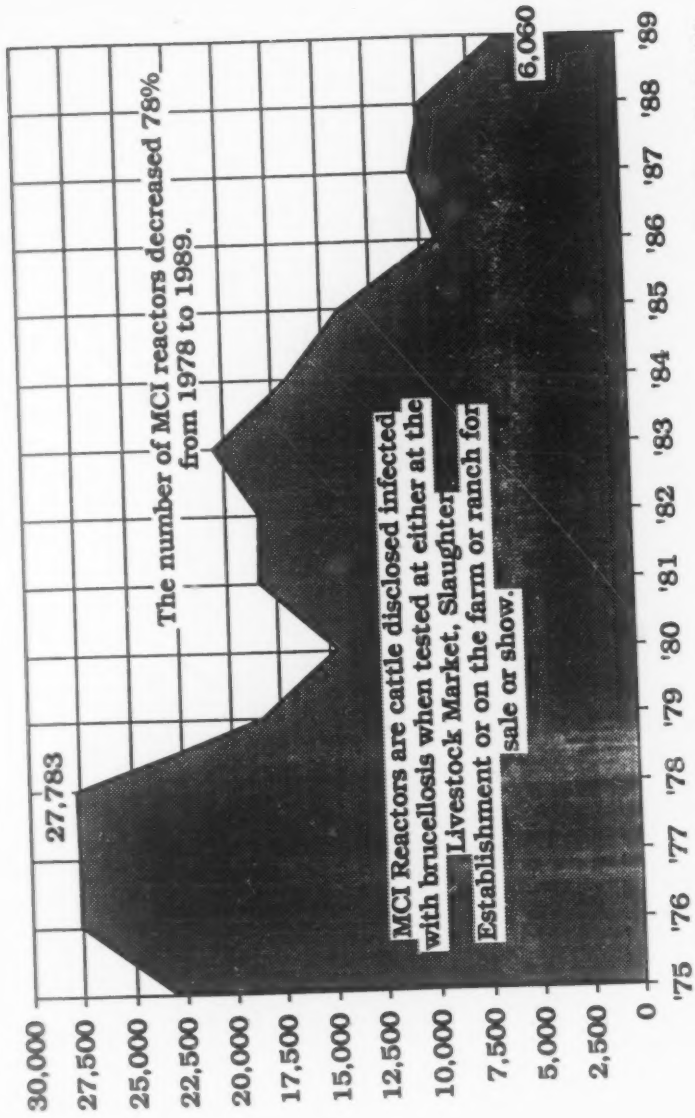
NUMBER OF MCI TESTS BY FISCAL YEAR



Produced by TAHC

Chart 3

NUMBER OF MCI REACTORS DISCLOSED BY FISCAL YEAR



Produced by TAHC

NUMBER OF
CERTIFIED BRUCELOSIS-FREE HERDS
BY FISCAL YEAR

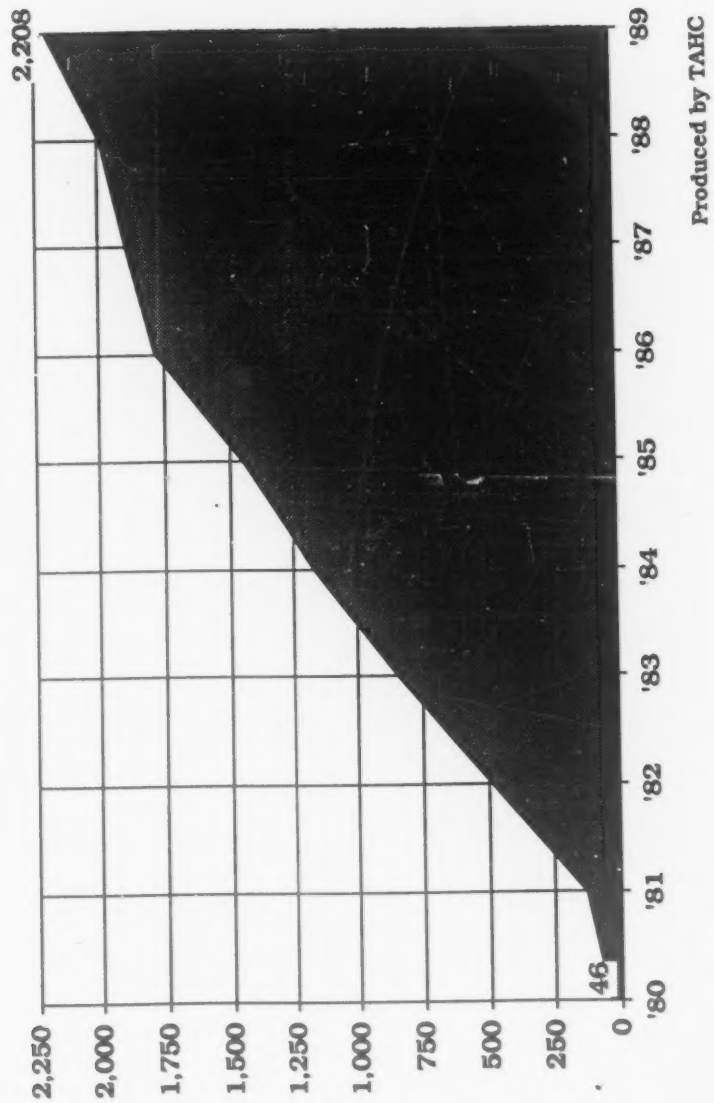


Chart 5

TESTIMONY SUBMITTED BY
Taylor H. Woods, D.V.M.
Director
Arkansas Livestock & Poultry Commission

Thank you Chairman Stenholm, distinguished members, ladies and gentlemen for the opportunity to testify before this august committee concerning brucellosis.

I am Dr. Taylor H. Woods, Director of the Arkansas Livestock and Poultry Commission and Vice Chairman of the USAHA Brucellosis Committee. I thank you for the privilege of appearing to exchange information at this grassroots level of our neighboring states.

We, in Arkansas, feel that the eradication of brucellosis is a very must situation. Our Governor, Bill Clinton, and Jim Baker, Chairman of our commission as well as our full commission are totally behind our eradication effort. With the help and support of our Farm Bureau and Cattlemen's Association, we strived to make each individual player in the disease eradication effort aware of their responsibilities. These individual players being producers, veterinarians, market operators, traders, state and federal workers, extension agents, and the general public. We have seen without proper education efforts being produced, that any one of the aforementioned segments can greatly hinder the eradication move. I believe that now is the most important time for the players to be in a position to do their part. We in Arkansas have 65 infected herds. We are looking to go Class A this fall and with the attitude of the general public and producers in the state, we are moving forward with our program; but, we need to take a look at what is happening to the federal government. Since the federal government has said they will be out of the program by budget year 1991, a state has the following options:

- a. A state may not do anything but go downhill with its program.
- b. A state can abide by what money alone APHIS will give them.
- c. A state may develop its own monetary program to carry it through eradication, or
- d. Encourage APHIS to adopt the Rapid Reduction Plan.

Option 1.

Arkansas has seen its share of hard times from brucellosis. In 1973 we had 250 infected herds. From there, we hit a peak in '84 with 691 and were declassified from B to C in August of that year. We regained our Class B in January of 1987 and are looking forward to Class A at the end of this year. We have seen this move cost our producers millions of dollars because we could not be competitive with the neighboring states for breeding animals. Presently, we feel it costs us \$8 Million Dollars per month to be in Class B. We feel for us to move to Class A, that not only the monetary situation must be handled, but internally our regulations and laws, with the proper follow through with compliance, has to be in order. So you see we cannot do nothing.

Option 2.

We feel that APHIS funding will either be reduced or non-existent in their '91 budget. This is the appointed time when funding is to be reduced to \$35 Million Dollars and the VMOs and AHTs are to be reassigned to problem areas outside of brucellosis, except for monitoring and compliance. At this level of funding, it would probably be the year 2000 before we could be free of the disease, so this is not acceptable to us.

Option 3.

This is where the state of Arkansas is and wants to maintain. We expect nothing but the very best in the brucellosis program, as we can see this is the only way for us to be free. We believed the federal government when they told us they were going to be out of the brucellosis program in their '91 budget year and we developed our program accordingly. We started advising our industry three years ago of this move and in working with the industry and legislature, we passed a \$1 check-off program this last legislative session and it is now in effect. This check-off works exactly like the National Beef Check-off except that we keep

all of the money. The check-off is \$1.00 per head for each animal that changes hands, whether they be at the market or on the farm. This check-off will replace the loss of federal funds and be able to maintain a strong brucellosis program in the future. Our \$1.00 check-off is built into the budget, so every two years we review the situation.

Option 4.

This could probably be another great effort through our states if APHIS would adopt the Rapid Reduction Plan. This plan was developed by Dr. Glosser and his staff at the request of the National Cattlemen's Association. It has been reviewed and resubmitted to APHIS as an acceptable plan. Of course the problem here lies with funds for the program. There are a few indications at this time that the plan is reasonable because:

- (1) We only have 1,900 plus infected herds in the United States.
- (2) When we look at overall funding levels and eradication points within certain states, we feel this will be the only way some states will be able to carry out their eradication plan.
- (3) As long as there is a foci of infection in the United States, then all states are still at risk.
- (4) Since most of our livestock today are in free and A states, those states with infection are paying for the disease monetarily and are still being hurt within their respective industries.

The Rapid Reduction Plan could be of great importance to the states like Arkansas and Oklahoma if we reach the free status before Louisiana and Texas. The 1990 funding year for APHIS reduced their budget \$10 Million Dollars and this had a large impact on several states. If we follow the same senario and continue reducing the budget to the \$35 Million Dollars as projected, then work in several states will stop. However,

to spend money without a state's monetary structure being sound towards eradication meets disfavor with my commission. We feel that a short length of time should be used in working the Rapid Reduction Plan. We also feel that all of the small details should be in place and the UM&R should be followed exactly if a state is going to progress with the federal tax dollars. In our opinion, laws and regulations necessary to carry out the Rapid Reduction Plan should be in place before money is offered or at least at the same time money is offered. Some states will not be in a position to carry forward the Rapid Reduction Plan even if funds are available. So, caution should be used here for progress to be monetarily worthwhile.

New technology must be used. The PCFIA and/or ELISA test systems allow us to concentrate more on the truly field infected herds. This new technology also affords us a better use of adult vaccination and calfhood vaccination. With the use of the liquid adult vaccine and taking advantage of depopulation where feasible, we can reduce or stop the community spread of the disease. In Arkansas, we are presently requiring herds to either be depopulated or adult vaccinated as ruled by the designated epidemiologist.

Mr. Chairman, the state of Arkansas is not only interested in our program, we are interested in seeing this disease eradicated nationally. Calfhood vaccination is an area that is going to be talked about in certain states to be stopped and we simply cannot allow this to happen until all states are free. We must see some leadership developed at the federal level to guide the disease control, the funding level, and the compliance level to continue to work with the states for eradication.

Arkansas itself is set and ready. We feel we can handle our problems but we will be haunted thereafter by a foci of infection outside of our state until all states get to the same level of infection (Free).

Thank you for this opportunity, Mr. Chairman. I would be happy to answer any questions.

TESTIMONY OF ERWIN F. WORKMAN, JR., Ph.D.
VICE PRESIDENT, RESEARCH AND DEVELOPMENT
IDEXX CORPORATION

to the

House Committee on Agriculture
Subcommittee on Livestock, Dairy and Poultry
Stillwater, Oklahoma
September 23, 1989

It is a pleasure for me to be here today and I appreciate the opportunity to review the evolving diagnostic technologies that have and will continue to positively impact our ability to eradicate important diseases of animals such as brucellosis in cattle. Examples of such technologies are shown in the first slide. As most of you know, immunoassays have been around for a long time but they continue to evolve in terms of accuracy, ease-of-use and automation. DNA Probe assays are just beginning to come onto the scene but offer possibly the ultimate in terms of specificity. And finally, biosensors offer the potential for fountain pen-size dip and read systems which can be used in the laboratory as well as in the field.

Immunoassay systems have evolved dramatically over the last several years from the early systems shown here which include simple agglutination tests, coated tube tests, coated bead tests, microtiter plate tests to sophisticated automated sample-in answer-out systems as well as quick, easy-to-use and accurate in-field or in-clinic systems. Such advances in immunoassay technology have been applied to laboratory and in-field testing for Brucella abortus. The IDEXX PCFIA test system as shown in

the next slide is a fluorescence based automated immunoassay system which provides sample-in-answer-out capability to the laboratory. To perform this assay the technician simply pipettes samples into the 96-well plates, loads 10 plates into the magazine of the instrument, and pushes go on the touch screen. The instrument performs the rest of the assay protocol automatically as follows:

- Adds antigen coated particles
- Adds fluorescent-labeled antibody
- Filters reaction mixture, separating bound from unbound labeled antibody
- Washes particles
- Measures bound fluorescein labeled antibody by front surface fluorimetry
- Sends data to IBM computer, which calculates, prints out and stores results.

The throughput capability of the system is shown in the next slide. As you can see one instrument with one technician can perform 3 runs a day or approximately 3,000 samples per day which extrapolates to around three quarters of a million samples per year. In addition to the automated system, a less automated instrument is available which may be more appropriate for smaller laboratories. Furthermore, it is relatively portable and, in fact, has been taken to large ranches for on-site testing.

PCFIA benefits for brucellosis testing include enhanced sensitivity, reduced labor, quicker throughput, and increased specificity; all of which equate to better results with no increase in costs. An additional benefit for the PCFIA system is that it is capable of simultaneously testing for multiple diseases since it can monitor up to four different wavelengths. In the next slide you see results from a combination test for antibody to Brucella abortus as well as antibody to infectious bovine rhinotracheitis (IBR). Brucellosis results are shown in green while IBR results are shown in red. Utilization of the PCFIA system for simultaneous testing obviously increases the efficiency of testing programs since the majority of the expense is in the collection of sample.

Responding to the need for a highly specific in-field assay with sensitivity matched to the PCFIA system, we employed our state-of-the-art membrane filter technology that a lot of you know as CITE. The CITE Brucellosis test is a USDA licensed product, has built-in controls, is quick and easy to use, and has improved sensitivity and specificity compared to the products now used in in-field situations such as the livestock market. Performing a CITE Brucellosis test requires a 5-step protocol and about ten minutes total time. Results are interpreted by comparing the color that develops in the sample spot which is in the twelve o'clock position with the color that develops in the standard curve at the nine, six and three o'clock positions. The low control in the nine o'clock position is calibrated to the .7 cutoff in PCFIA while the control at the three o'clock position

is calibrated to the reactor level cutoff at .25 in PCFIA. At this point the CITE Brucellosis test is primarily used on vaccinated animals that test CARD positive at the livestock market. There are now many examples where subsequent testing with CITE has been negative and follow-up testing by PCFIA, CF, and Rivanol have confirmed the negative CITE result. For example, this calfhood vaccinate tested CARD positive and CITE negative at the market. Supplemental lab testing showed negative on PCFIA, Rivanol and CF. In another example, the CARD test was positive on an adult vaccinated animal while a CITE test run at the market was negative. Lab tests showed PCFIA, Rivanol and CF to be negative. This is not to say that the CITE test lets all CARD positives off the hook and as shown in the next slide CITE confirmed the CARD positive at the market. This animal was subsequently classified as a reactor with Rivanol and CF. Furthermore, CITE was compared to the CARD test in a study of 714 culture positive animals. The CITE test identified 1% more positives than the CARD test.

Even the CITE technology continues to evolve and IDEXX has already introduced into some of our markets a new assay device called CITE Probe. CITE Probe further simplifies immunoassays without sacrificing accuracy or multiple analyte capability by eliminating the need for accessory bottles of reagents, measurement of any volumes, and refrigeration.

In terms of simplicity and ease-of-use, however, the ultimate tool for a diagnostician would be a device that could be simply placed in a sample and within a few seconds provide an electronic readout of the result - much as one now does measuring the pH of a solution. Biosensors offer this potential. For your information I have defined biosensors as the synergistic combination of biochemistry and microelectronics where immobilized biological materials like antibodies or enzymes are in intimate contact with a transducer device which converts a specific molecular recognition into a quantifiable signal such as a charge, heat, light, etc. We have an active program on biosensors and hopefully in the near future we can bring this technology to bear on animal health issues such as brucellosis surveillance.

Finally, another technology that has been rapidly evolving from a research tool to a practical diagnostic method is the DNA probe assay. Within a couple months, we will introduce the first non-isotopic DNA probe test into the veterinary market place. This assay will be a test for the presence of Mycobacterium paratuberculosis which is the causative agent of Johne's disease in cattle. This test appears to be more sensitive and more specific than the current culture methodologies which can take months to produce results. It is conceivable that a DNA Probe test could facilitate the confirmation of Brucella abortus infections by replacing the current six week culture procedure.

In summary, it seems clear that the evolution of diagnostic technologies driven by advances in biotechnology and electronics has had and will continue to have a very positive effect on our ability to diagnose and eradicate diseases such as Brucellosis. I would urge this committee both to maintain an awareness of such technologies and their potential impact on the livestock, poultry, and dairy industries and to take the appropriate actions to support their rapid implementation even when substantial changes to current systems are required.

TESTIMONY OF DAVID E. SHAW, PRESIDENT
IDEXX CORPORATION

to the

House Committee on Agriculture
Subcommittee on Livestock, Dairy and Poultry
Stillwater, Oklahoma

September 23, 1989

It's a pleasure to be here today to discuss the role of new technology in the eradication of bovine brucellosis disease.

I'm sure that I share the view of many people here today when I say that the timing of this hearing on the subject of new technology is particularly opportune. In the past several years we have begun to witness a technological revolution of major proportions in biological sciences. It is a revolution that will rival in proportion and in impact the revolution in electronic technology that began several decades ago.

Among it's many other benefits, the biotechnology revolution has very important implications on the ability to quickly and accurately detect animal diseases as well as contaminants in food and feed. As others here have discussed today, brucellosis surveillance has already benefitted considerably from this revolution, and the opportunity exists to significantly broaden this impact in the future. This opportunity applies not only to the brucellosis program, but to the control of other economically serious diseases in livestock and poultry, and as I mentioned earlier, to a broad range of food and feed contaminants.

Because of my company's particularly strong expertise in biotechnology-based diagnostic and surveillance systems, I would like to focus my remarks on several issues related to this specific area.

First of all, I would like to acknowledge the very supportive role that this committee and others in the room have played in the recent introduction of several important new technologies to the brucellosis program. Both CITE technology and PCFIA technology, which have been mentioned by others today, have received a great deal of support by members of this committee, by state and federal officials, and by the cattle industry. Thanks to this assistance, these powerful new technologies have begun to have a very important impact on the accuracy and speed of brucellosis testing in many states. PCFIA is now used at 25 sites in 17 states to test roughly 10 million samples per year with unprecedented accuracy. CITE is used in more than 25 states to reduce the adverse impact of inaccurate test results in field testing situations such as cattle markets.

In view of the theme for today's hearing, an important point to make regarding the new CITE and PCFIA technologies is that they represent a very noteworthy trend towards far greater use of private sector technology in a market traditionally served largely by government sources. Unlike most other technologies and surveillance systems which preceded them, CITE and PCFIA were developed with private capital. However, the successful

implementation of these systems has required a very unusual and possibly unprecedented degree of interaction between government livestock officials and private industry--in this case, IDEXX Corporation. Given the increasingly crucial role that private firms will clearly play in providing technology for surveillance of brucellosis and other animal diseases in the future, the encouragement of such interaction should become a higher priority objective than ever before. Issues to be considered in this regard by this committee and others policymakers range from the evaluation and approval of new tests and technologies, to creation of new structures for cooperative public/private development programs. We believe that expanded public/private cooperation of the kind that has led to successful implementation of PCFIA and CITE technologies will be of great benefit to the cattle industry in the future.

Another point for consideration in the context of this hearing is that technologies applicable to improved brucellosis surveillance will also have great value for the detection of other animal diseases and, as I mentioned earlier, for the detection of food contaminants. PCFIA technology provides a good illustration of this point. This technology allows for simultaneous detection of multiple diseases on a single sample with little incremental effort by laboratory personnel. This technological capability has potentially far-reaching implications for the livestock industry. Samples collected at substantial expense for brucellosis testing and other programs such as swine pseudorabies

could potentially be tested for other diseases which have adverse economic consequences for the U.S. livestock industry. Diseases such as IBR and BLV in the beef cattle and dairy industry are increasingly the target of eradication efforts in various parts of the world such as Europe. The same is true for various poultry and swine diseases, and we have seen a great deal of interest in improved surveillance for food contaminants such as mycotoxins, drug residues, pesticides, and microbial pathogens. New technology will play a crucial role in dealing with these issues. And, while today's hearing focuses on new technologies for brucellosis applications, it seems very appropriate that broader consideration be given to the use of these new surveillance technologies for other important applications benefitting the U.S. livestock industry. Never before have technological capabilities offered the opportunities available today for very rapid and accurate detection of a broad range of analytes.

I would also like to briefly address the subject of financial resources needed for implementation of new surveillance technologies. Because the implementation of CITE and PCFIA technologies were novel programs, no established mechanisms were in place for their implementation, and their success to date has been the result of extraordinary efforts by many state and federal officials. An important obstacle to overcome, for example, was that the early stages of implementation of new technology frequently requires a commitment of additional

financial resources. This is necessary even though the rationale for introducing new technology for brucellosis and other surveillance needs is to ultimately reduce costs and improve the economics of disease control efforts. Needless to say in a time of tight budgets, the potentially great benefits of technologies such as PCFIA and CITE can be jeopardized by waivering of support in the often frustrating but crucial early stages of implementation. The need exists to implement PCFIA in as many as 10 additional states and to add data processing capabilities to maximize the utility of this technology in the final eradication of brucellosis. Without the commitment of adequate financial resources, the power of this or other new technologies will be lost and a very successful new program will be stifled before it is able to return significant benefits to the cattle industry. The same is true for surveillance systems applicable to other animal diseases and food contaminants. The considerable power and potential benefits of these technologies cannot be realized without a commitment to significant levels of investment spending in the first several years of a new program.

In this new era of increasingly sophisticated disease detection technology, I believe that the barrier to better disease surveillance will become more a matter of resources and organizational structure than technological ability. Innovative but proven structures such as the National Poultry Improvement Program offer successful models for cooperative government and industry initiative to address the eradication of animal diseases

and food contaminants. This kind of program applied to livestock industries could offer great promise in addressing a broad range of health monitoring needs. We envision that diseases such as bovine leukemia, Johne's disease, IBR, swine pseudorabies and others will increasingly come to the forefront of livestock disease eradication efforts, and in fact this trend is well underway in Europe and in certain parts of the U.S. Technologies now being applied to brucellosis eradication can impact these diseases with the assistance of an unprecedented level of private capital and initiative if appropriate programs are put in place to accomplish this.

In summary, I believe that this hearing comes in the midst of an important new era in the evolution of surveillance technology and therefore at an extremely opportune time for considering ways to harness these new technologies for the benefit of livestock producers. It is clear that improved surveillance via new technologies has the potential to significantly improve the economics of animal industries and to better ensure the wholesomeness and safety of animal-derived foods such as beef, pork, poultry and milk. If the appropriate resources are made available, brucellosis eradication should be a relatively short-term objective given the increasingly sophisticated tools available to accomplish this. Longer term, we hope that the technological capabilities that have been brought to bear on the brucellosis program and other applications such as poultry diseases and swine pseudorabies can be applied to a much broader

range of needs. However, this will not happen in the absence of positive action by public policymakers. Neither consumers nor producers will benefit from these opportunities without an appropriate allocation of resources and a new era of creative public/private relationships to facilitate the implementation of new technology.

Again, thank you for inviting me to discuss these important issues. I would glad to address any questions that you may have.

Testimony Submitted

by

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Before

the

SUBCOMMITTEE ON LIVESTOCK, DAIRY, AND POULTRY
COMMITTEE ON AGRICULTURE
U.S. House of Representatives
Noble Research Center
Oklahoma State University
Stillwater, OK

concerning

TECHNOLOGICAL ADVANCEMENTS AND OTHER
MEASURES LEADING TO THE COMPLETE ERADICATION
OF BRUCELLOSIS--THE PAST, PRESENT, AND FUTURE

September 23, 1989

Testimony of L. Garry Adams

Committee members of the Subcommittee on Livestock, Dairy and Poultry of the Committee on Agriculture, Honorable Mr. Chairman, and ladies and gentlemen, I am pleased to provide testimony today on the subject of "Technological Advancement and Other Measures Leading to the Complete Eradication of Brucellosis--The Past, Present and Future." I will review the technological accomplishments from a scientific perspective using a focused outline format.

- THE DISTANT PAST - PRIOR TO LATE 1970'S

- Incidence of brucellosis in U.S.A. cattle herds reduced from 15 - 20% to about 3%
- Incidence of human brucellosis reduced in parallel with the reduction of brucellosis in cattle
- Reduction in disease incidence accomplished through:
 - Use of early stage of development serologic tests at herd level
 - Vaccination with large dose strain 19 calfhood vaccination
 - Depopulation and slaughter of serologically positive cattle
- Early brucellosis program reduced disease incidence to a level so that control became feasible
- Deficits of the early brucellosis disease program
 - Deficiency of scientific knowledge base
 - Deficiencies in funding, education and training
 - Misplaced responsibilities for herd health management
 - Inconsistent policies and epidemiologically unsound regulations
 - Inadequate high quality services

Testimony of L. Garry Adams

• THE RECENT PAST - FROM LATE 1970'S TO PRESENT

- Reviews of the basic knowledge and the concept of eradication of bovine brucellosis
- National Academy of Sciences-*Brucellosis Research: An Evaluation*-1977
 - Review of status of U.S.A. brucellosis infection in cattle
 - Increasing incidence of infection
 - Decreasing in calfhood vaccination
 - Decreasing in certified brucellosis-free counties
 - Review of concerns and apparent shortcomings of the regulatory program
 - Need for improved quantity and quality of laboratory testing
 - Need for improved supervision and reporting of herd, county, state, and national disease status
 - Need for permanent identification of exposed, infected cattle
 - Clearer definition of responsibilities of regulatory personnel and owners
 - Improved management of brucellosis research administration
 - Re-evaluation of epidemiologic soundness of Uniform Methods and Rules
 - Discovery of new fundamental research concepts and contributions inadequate
 - Need for serologic tests to distinguish Strain 19 vaccine titers from titers due to field strain infection
 - Need for improved, safe vaccines whose immune response could be distinguished from field strain infection
 - Need to define the components of the protective immune response
 - Need for fundamental knowledge of the mechanisms of how *Brucella abortus* causes disease, e.g. latent infection

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- Need to expand the knowledge on disease transmission, reservoirs and other epidemiologic factors
- National Brucellosis Technical Commission - *Concept of Eradication* - 1978
 - Control leading to local eradication of brucellosis is biologically feasible
 - Biological knowledge to accomplish control leading to local eradication is available
 - As opposed to no regulatory program, any regulatory program has favorable benefits to consumers
 - Indemnity payments are appropriate to use as incentives
 - Epidemiologic data base inadequate for evaluation of regulatory program performance
 - Permanent nonduplicative individual identification of cattle is essential
 - Increases in the prevalence of bovine brucellosis is directly associated with incidence of human brucellosis
 - Uniform Methods and Rules evolved to contain barriers to the achievement of control leading to local eradication
 - Multiple cost-effective and biologically efficient surveillance procedures are essential
 - Research funding should be provided at high, sustained levels to expand fundamental knowledge base
- Research and regulatory program funding was increased
- Incidence of cattle herd infections in the U.S.A. reduced to less than 0.2%
- Uniform Methods and Rules improved for epidemiological soundness, yet allow flexible herd plan development with producers
- Expansion of fundamental knowledge increased significantly
 - Impact of biotechnology on development of diagnostics and vaccines

Testimony of L. Garry Adams

- Impact of electronic communications and computer technology
- Application of modern antibody detection technology
- Impact of semi-automated, automated and robotics technology

• THE PRESENT

- Progress of the National Brucellosis Regulatory Program
 - The regulatory program is making excellent progress - only six states have a herd infection rate of 1.5% or less
 - Focused incremental increases in epidemiologically sound control measures employed through meaningful dialogue between livestock industry and government
 - Electronic data base is now in continuous use and expanding
 - Adoption of new automated serologic procedures
 - Continued use of reduce dosage Strain 19 vaccination for calves and adult cows
 - Improved quality of laboratory diagnostic procedures
 - Brucellosis control leading to local eradication and ultimately national eradication becoming increasingly feasible
- Rapid expansion of fundamental scientific knowledge base
 - Application of molecular genetics to *Brucella abortus* for taxonomy, cloning, and understanding the genetic basis of disease causation
 - Chemical, structural and molecular properties of protein and carbohydrate antigens of *Brucella abortus* membranes are being identified
 - Molecular biology beginning to unravel the basis for invasion and survival of *Brucella abortus* in the cow
 - Application of biotechnology points the way to identifying protective antigens
 - The protective immune response of the cow to *Brucella abortus* is becoming clearer

Testimony of L. Garry Adams

- The genetic basis for natural brucellosis resistance in cattle is documented and being mapped
 - The cellular mechanisms for recognizing and killing *Brucella abortus* in cattle are being actively pursued
 - Killed and live sub-unit brucellosis vaccines are ready for evaluation in laboratory animals and cattle
 - Differential diagnostic antibody detection assays, antigen capture assays and DNA hybridization probes for more rapid and accurate diagnosis have been developed for evaluation in cattle
 - Epidemiologic and econometric simulation models of bovine brucellosis have been developed for regulatory program decision making
 - American bison, elk and feral swine have been documented to be transmitters of brucellosis to cattle
 - Eradication of brucellosis in large extensive cattle operations has been documented
- THE FUTURE - THE 1990's
 - New Discoveries through Basic Research
 - Genomic map of *Brucella abortus* will be completed to identify virulence factors, diagnostic antigens and protective antigens
 - The evolutionary and taxonomic relationship of *Brucella spp.* will be reconciled with their respective mammalian hosts
 - Antigens inducing protective immunity will be cloned and expressed in other organisms
 - The basis and regulation of the protective immune response of cattle will be determined
 - The genes responsible for natural brucellosis resistance will be identified, cloned and mapped
 - The functional and structural basis of *Brucella* membranes and lipopolysaccharide antigens will be defined

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- The strategies by which *Brucella abortus* invades, survives and causes abortions will be elucidated
- Implementation of basic research findings as to specific applications
 - Cloned *Brucella* genes expressed in other carrier organisms will form the basis of live sub-unit vaccines which can be differentiated from field strain infections
 - Monoclonal antibody-based fully automated immunoassays will differentiate vaccination serologic reactions from field strain serologic reactions in the field
 - Confirmed diagnosis will be determined by DNA hybridization probes within hours
 - DNA hybridization of sperm or white blood cell DNA will allow selection for natural brucellosis resistance
 - Transfer of bovine genes responsible for brucellosis resistance to fertilized ova will produce transgenic animals naturally resistant to brucellosis
 - Approved procedures and regulations to evaluate recombinant vaccines in large domestic animals will be required

Obviously, we are not at the beginning of the issue of brucellosis eradication, but neither are we at the very end of the story. Rather we are in the last few chapters of the book where the pieces of the mystery begin to converge, yet before the final solution becomes evident. Clearly, the last ten years of basic brucellosis research have been important in providing a clearer understanding of how *Brucella abortus* causes disease in cattle, the molecular basis of why cattle do or do not develop protective immunity to overcome the disease, how very subtle changes in the structural and molecular composition of the organism's membranes either increases or decreases its ability to survive inside the cow's cells and other basic findings that do not seem directly relevant to the eradication of brucellosis. Yet, basic research often turns out to be practical, and we often need to be reminded that research is a process and that apparent "breakthroughs"

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are usually no more than advances on a very long continuum and are almost always the result of a great deal of previous research. That is to say new end-products of science are almost invariably the result of a long chain of small advances.

Thus, it becomes increasingly important to provide continued levels of adequate funding to nurture the sustained scientific process that results in new fundamental discoveries leading to practical applications. Indeed, sustained Federal support has been funded through USDA-Cooperative State Research Service, Competitive Grants and Animal Health section funds as well as through USDA/Agriculture Research Service and USDA/Animal Plant and Health Inspection Service. These funds support honorable national competition often leading to scientific cooperation in the quest for new knowledge pertaining to brucellosis in cattle. Of course, the funds provided to the USDA is approved through U.S. House of Representative's Committees on Agriculture and Agricultural Appropriations, and it is your generous support that has allowed the entire scientific national community the opportunity to address and pursue these issues to a logical and practical end. We as scientists are grateful to you for your support and respectfully request that we be allowed to write the final chapter in the book and solve the mysteries to complete the eradication of bovine brucellosis from the United States.

Testimony submitted by:

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Before The House Agricultural Subcommittee on Livestock,
Dairy, and Poultry.

Concerning technological advancements and other measures
leading to the complete eradication of brucellosis -
the past, present and future.

Noble Research Center
Oklahoma State University
September 23, 1989

Mr. Chairman, I am pleased to be here today to discuss technology transfer and the brucellosis program in Oklahoma.

Since its establishment in 1948, the College of Veterinary Medicine has taken seriously its three missions of teaching, research and service (extension). It is this latter area that I will share with you today. The Administration of the College has long held the view that it is not enough to accumulate and interpret basic knowledge, but rather to actively disseminate new knowledge and provide technical assistance to the various external clients interested in the information generated by university faculty and staff. The dissemination of this knowledge includes many traditional mechanisms including conferences, colloquia, and symposia; publications, extension programs, producer advisory committees, educational exhibits and individual contracts. While many forms for communication can be utilized, the goal is always the same - to fulfill the mission of disseminating research for today and tomorrow.

The College of Veterinary Medicine extension program is organized under an Assistant Dean for College Outreach who reports directly to the Dean. Of the five faculty assigned to the outreach program, two are beef cattle specialists involved directly in the delivery of extension and continuing education programs. In addition, veterinary medical services are delivered through the food and fiber animal section of the Boren Veterinary Medical Teaching Hospital and the veterinary ambulatory and herd health services. Specialties represented in these services include internal medicine and theriogenology (reproduction and reproductive diseases). The College of Veterinary Medicine has the responsibility for the administration, staffing

and operation of Oklahoma's only animal diagnostic laboratory. Professional staff of the Oklahoma Animal Disease Diagnostic Laboratory (OADDL) includes specialists in pathology, bacteriology, virology, toxicology and parasitology. Often the first indication of a potential disease outbreak comes from samples submitted to OADDL, as it represents Oklahoma's first line of defense against potentially devastating livestock problems.

Brucellosis, also known as Bang's disease, is a reproductive disease of cattle that costs livestock producers millions of dollars each year. A campaign to control brucellosis would not only help cattlemen with infected herds, but reduce their financial loss, and also make a marked difference in brucellosis infection rates.

Brucellosis technology transfer had its beginning in 1982 following an agreement between ARS, the College of Veterinary Medicine and the Kerr Foundation to establish the Livestock Health Research Center at Hugo, Oklahoma. The Research Center was established to look at new brucellosis vaccines and/or improvements in the currently used vaccine.

The Kerr Foundation's (later the Kerr Center) role was two-fold: (1) the day-to-day management of the facility and cattle, and (2) dissemination of the results of studies conducted at the center. (In 1988 the College of Veterinary Medicine assumed these two roles as well as all associated funding).

In 1983 the Conference of Innovative Approaches to Brucellosis Prevention was held at the Kerr Conference Center in Poteau, Oklahoma. Seventeen research scientists, a large animal veterinarian, agriculture

economist, animal scientist and a cattleman joined Congressman Wes Watkins in a 2-day meeting discussing and planning brucellosis research needs.

One of the findings of this group was that over 80% of the problems with brucellosis eradication appeared to be a lack of understanding of the disease by the cattle producers and others, including veterinarians in areas of high infection rates. The group recommended the establishment of a center for collecting and digesting of research results and finding innovative ways to encourage the implementation of practices to reduce the incidence of brucellosis.

Following the Conference the Animal Health Information and Technology Transfer Center was established through a grant from USDA, ARS and the Kerr Foundation.

In August of 1983, an advisory group met to draw up specific goals for the information project. This group consisted of veterinarians, a rural sociologist, communications expert, and an extension specialist.

A target area was established which consisted of 5 counties in SE Oklahoma, 7 counties in NE Texas, 12 counties in SW Arkansas, and 2 parishes in NW Louisiana. The target area contained 9.5% of the known brucellosis in the U.S. but only 1.3% of the total cattle herds in the U.S. The area contained over 21,000 herds not known to be infected, but considered to be at risk.

Goals were established including the following:

1. Information gathering about not only the disease prevalence, but basic demographic sociological, geographic and economic information about the

area.

2. Develop a newsletter designed and targeted for selected audiences.
3. Implement various mass media campaigns to present the factual information about the disease and its prevention and control.

In 1985 the target area was expanded to include the following states: Arkansas, Florida, Louisiana, Mississippi, Oklahoma and Texas. These 6 states contain over 90% of the known brucellosis in the U.S. Funding was supplied by both USDA, APHIS and ARS.

Accomplishments of the Project include:

1. Produced 12 fact sheets dealing with various aspects of the disease. To date, over 600,000 have been distributed not only to the 6 targeted states, but to all other states and several foreign countries.
2. Produced and distributed other educational material i.e. vaccination brochure of which over 250,000 have been distributed.
3. Two newsletters, Cattle Industry Leaders and Veterinarian are produced quarterly and sent to producers, agriculture leaders, educators and veterinarians primarily in the 6 targeted states. The combined circulation of these newsletters is over 10,000.
4. Public Service announcements - both video and radio were produced and widely used in the target area.
5. A socio-economic study was conducted and results used in targeting specific problem areas.
6. Literally hundreds of meetings were attended and a booth was provided to distribute information. These meetings ranged from large national

meetings with thousands in attendance to small county fairs and producer meetings with a few as 19 people in attendance.

7. Poster and essay contests were sponsored and involved FFA students in Oklahoma and Arkansas.

8. News releases were prepared and widely distributed and used throughout the area.

9. Speakers and programs were provided for requesting agricultural groups throughout the area.

10. Educational slide/tape sets were produced and distributed throughout the area.

Within the teaching hospital, the ambulatory and herd health services and the Oklahoma Animal Disease Diagnostic Laboratory, individual livestock owners experience one-on-one contact with animal disease specialists. In addition, the diagnostic laboratory widely distributes to veterinarians a monthly newsletter and timely reminders of existing and potential disease problems including brucellosis. Faculty members are available through the College's herd health program to directly investigate brucellosis outbreaks and to work with the attending veterinarian and the herd owner to prevent spread of the infection, minimizing losses, and prevent reoccurrence.

To date technology transfer has been accomplished primarily through rather conventional methods. In the future, more use will be made of the new electronic technologies that are appearing daily. Agriculture in the United States is at a major turning point as it enters the information communication age. In fact, some agricultural scientists indicate that the computer is

possibly the most significant technological invention in U.S. agriculture today. D.W. Dik and C.B. Travieso write:

"Electronic technologies are swiftly becoming pervasive. The United States is only 3 or 4 years away from having the major social and economic forces shift from mass society and the industrial age to the information age. It is through this major social and economic transformation that research and extension will fashion new methodologies to extend and translate new knowledge.

New information technologies have the potential to radically change the way individuals live, work, are educated, and use their leisure time. These technologies, along with convergent social changes, will induce significant transformations in the educational programs and activities of the entire research and extension community of the land-grant system, including the national, state, regional and county levels."

In addition to computers some of the new electronic technologies that will increasingly gain application in technology transfer include: (1) satellite delivery systems; (2) video-cassettes; (3) interactive videodisc; (4) compact disks and; (5) electronic networks.

The application of these and yet undiscovered methods of disseminating research for today and research for tomorrow will help ensure success in the battle for elimination of brucellosis and other disease problems in our livestock herds and flocks.

The College of Veterinary Medicine will continue working with individuals and organizations throughout the South to fight livestock disease not through regulation, but by extending information and technology to producers, veterinarians and the general public.

Mr. Chairman, thank you for the opportunity to share this information on brucellosis technology transfer.

ANTHONY W. CONFER, DVM, PhD
Professor and Head,
Department of Veterinary Pathology
Oklahoma State University

Mr. Chairman and members of the committee, scientists in the Colleges of Arts and Sciences and Veterinary Medicine as well as the Division of Agriculture, Oklahoma State University in cooperation with the U.S. Department of Agriculture-Agricultural Research Service, the Kerr Center for Sustainable Agriculture and the Oklahoma Agricultural Experiment Station have been actively involved in bovine brucellosis research since 1982. We have been studying brucellosis with three questions in mind. These are:

1. How can the diagnosis of brucellosis be improved relative to testing accuracy and speed?
2. How does the causative bacteria, Brucella abortus, interact with the host in both susceptible and immune cattle?
3. How can a new vaccine be developed that stimulates better immunity and is safer than the current Strain 19 vaccine?

Answering these three questions would be consistent with the recommendations from the Kerr Brucellosis Conference held in 1983 and the Federal Brucellosis Eradication Program.

DIAGNOSIS

Accurate and rapid diagnosis of brucellosis in cows, calves, and aborted fetuses has always been a great concern for cattlemen. The methods of choice have been detection of Brucella-specific antibodies in serum (serology) from cows and calves and in milk from dairy cows and culturing of infected fetuses and milk samples for the organism. In our laboratory, studies were conducted and results published whereby quantitative fluorometric testing systems, originally developed for human clinical laboratories to diagnose viral infections, were adapted to detect Brucella-specific antibodies in cattle sera. Results indicated that these tests were more rapid than previously used

tests, but they did not increase the accuracy of testing and were too expensive to use in large herd testing programs. Scientists at other laboratories developed a competitive enzyme-linked immunosorbent assay (ELISA) that has been incorporated in many state and federal Brucellosis laboratories and has increased accuracy and rapidity of testing.

In the future, additional serological tests need to be developed that detect only true positive (field strain infected) cattle and no false positive (vaccinated) cattle.

In the laboratory of Dr. J.A. Bantle, Dept. of Zoology, O.S.U., a new, rapid diagnostic test, which is extremely sensitive and highly specific for B. abortus, has been developed using the latest methodology (the polymerase chain reaction). This assay detects the presence of Brucella DNA and is, therefore, analogous to culturing the organism. The polymerase chain reaction, however, is much more rapid and sensitive than conventional culturing techniques. The assay can detect the DNA from a single organism. DNA from 15 different bacteria, fungi and viruses failed to stimulate a false positive reaction.

It is envisioned that this test could be used in conjunction with other tests to diagnose infected, aborted fetuses. The sensitivity of the assay may be such that infection in adult cattle can be detected also. Additional research must be conducted before the test can be approved for routine use. The assay will be tested against as many organisms as possible to assure that cross reactivity is not a problem. Also, the assay must be tested in experimental cattle studies in conjunction with scientists at the USDA-ARS and the OSU College of Veterinary Medicine to see how it performs under field conditions.

BACTERIAL-HOST INTERACTIONS

Despite many years of research in brucellosis, scientists still do not completely understand the immune mechanisms that are activated in Strain 19-

vaccinated, resistant cattle. It is well known that high antibody titers to B. abortus do not stimulate resistance in cattle to infection. In fact, high antibody responses both in serum and vaginal secretions correlate with infection instead of with immunity to the organism. This observation as well as our limited understanding that B. abortus is an intracellular pathogen (i.e., it lives within and resists killing by phagocytes within the host) indicates that cell-mediated immunity probably plays a strong role in preventing infection with the organism.

Research in many laboratories, including those of Drs. A.W. Confer and J.H. Wyckoff III at the College of Veterinary Medicine, O.S.U., have in the past and are currently studying immunity to brucellosis using cattle and laboratory rodent models. Studies in our laboratory showed that strong lymphocyte proliferative responses to B. abortus (a measure of cell-mediated immunity) were higher in Strain 19-vaccinated than in nonvaccinated cattle and lower in cattle that aborted than in cattle that did not abort after challenge with virulent B. abortus. However, scientists who measured cell-mediated immunity by other assays, such as delayed-type hypersensitivity and leukocyte-migration inhibition, found that high responses were similar to high antibody titers, i.e., they correlated with infection rather than resistance. Therefore, our understanding of the role of cell-mediated immunity in bovine brucellosis has not been resolved and warrants substantial further study.

Dr. J.H. Wyckoff III, OSU College of Veterinary Medicine, is currently undertaking a rather unique approach to understanding immunity in bovine brucellosis. These studies center around investigation of both the molecules of B. abortus that stimulate the immune system of cattle and the functional nature of the responding immune cells. Currently, the primary research project is investigating the bacterial molecules (antigens) that stimulate helper T lymphocytes. These cells function in helping other cells of the

immune system perform optimally, such as helping B cells make antibodies, activating macrophages to kill bacteria and providing growth and activation factors for cytotoxic T lymphocytes which kill host cells infected with intracellular pathogens. It is hypothesized that a protected animal immune to B. abortus would have strong helper T cells to several important antigens of the bacteria, and this would be a critical component of immunity. To date, helper and cytotoxic T lymphocytes from Strain 19-vaccinated cattle have been cloned in cell culture and are being studied to determine which particular B. abortus antigens stimulate them. Use of B. abortus antigens obtained from gene libraries constructed through recombinant DNA technology by Drs. Bantle and Richard Essenberg, Dept. of Biochemistry-OSU, will be of utmost importance in future studies of the importance of these helper and cytotoxic T lymphocytes in stimulating immunity to brucellosis. Additionally, studies are ongoing in our and other laboratories to determine the role of helper T lymphocytes and various recombinant-DNA derived immune mediators such as bovine interleukin 2 (T Cell Growth Factor) in stimulating macrophages (cells that can ingest and kill bacteria) to kill B. abortus.

It is through understanding of the immune mechanisms involved in protecting cattle from brucellosis that effective new vaccine strategies can be developed. These strategies in combination with modern molecular biology technologies can produce more efficacious Brucella vaccines.

IMPROVED VACCINES

Although the currently used live B. abortus Strain 19 vaccine is highly efficacious, it is not without its problems. In some cattle, Strain 19 vaccination results in prolonged vaccine-induced titers resulting in a false positive reactions in standard serology tests. Occasionally, Strain 19 bacteria have been cultured from the joints of vaccinated cattle with chronic, severe arthritis. Accidental human infection with the vaccine is a constant

threat. Because of these problems, scientists worldwide have been actively trying to develop nonliving Brucella vaccines that would stimulate immunity, yet not have the negative side-effects of the current live Strain 19 vaccine.

In past studies, nonliving B. abortus vaccines have failed to induce immunity in cattle. Vaccination of cattle with killed B. abortus, such as Strain 45/20, stimulated antibody responses but not immunity. In a study at the Livestock Health Research Center in Hugo, Oklahoma, cattle were vaccinated with chemically modified and unmodified salt-extractable proteins prepared from B. abortus by USDA-ARS scientists Drs. L. Tabatabai and B. Deyoe, at the National Animal Disease Center. These vaccines induced an antibody response and some degree of cell-mediated immune response but failed to induce resistance to challenge with B. abortus. Results of these and other studies indicate several important things. First, immunity to brucellosis is not well-enough understood. Second, the important antigens that stimulate immunity to B. abortus are not known. Third, appropriate adjuvants (substances that augment the immune response to various antigens) need to be found for use with nonliving B. abortus vaccines.

Recent studies in our laboratory have concentrated on comparing the immune response induced with soluble B. abortus antigens containing various adjuvants to the immune response stimulated by Strain 19. Various adjuvants have been tested including Freund's complete and incomplete adjuvants, bacterial adjuvants-Bordetella pertussis, Propionibacterium acnes, synthetic adjuvants-muramyl dipeptide, and a surface-acting adjuvant-dimethyldioctadecyl ammonium bromide (DDA). In several nonchallenge experiments, DDA was found to enhance the immune response to soluble B. abortus proteins with reasonable consistency. Likewise, vaccination of calves with B. abortus antigens in conjunction with recombinant-DNA derived bovine interleukin 2 stimulated a positive immune response in a nonchallenge study. Preparations have been made and the experiment will soon begin to test the role of adjuvants in an

experiment whereby cattle will be vaccinated with soluble Brucella proteins containing bovine interleukin 2 and will be challenged with live B.abortus in mid-gestation.

An additional area under investigation by Dr. M.R. Sanborn, Dept. of Botany and Microbiology-OSU, is the use of recombinant-DNA derived B. abortus lipopolysaccharide [(LPS) a complex antigenic surface molecule] as a subunit vaccine for bovine brucellosis. Vaccination of mice with recombinant B. abortus LPS indicated that the LPS was antigenic and reduced the number of organisms in mice after challenge. In a cattle experiment, conducted at USDA-ARS facilities, cows were vaccinated with the LPS and immune responses monitored. The cows were challenged with virulent B. abortus in mid gestation. A classical immune response was detected following initial and secondary vaccinations as well as following challenge with the organism. Additional studies are ongoing with the recombinant-DNA derived B. abortus LPS. These include mapping and cloning of the genes for the LPS biosynthetic pathway. It is felt that mapping, cloning and subcloning of these genes will aid in development of an antigen which may be more suitable for vaccine production and provide recombinant-DNA derived LPS for studies of mechanisms of disease production in brucellosis.

CONCLUSIONS

In conclusion, in the last 5-6 years, scientists nationwide have made great strides in enhancing our abilities to diagnose brucellosis, in increasing our understanding of immunity to brucellosis, and in developing an efficacious nonliving vaccine. It is my opinion that the next 5 years will most likely be characterized by even greater accomplishments in these areas especially the latter. It is critical that funding for brucellosis research continue at the present or greater levels to assure that the results to date can be expanded and the research efforts can come to fruition.

COMMITTEE ON AGRICULTURE
HOUSE OF REPRESENTATIVES
FIELD HEARINGS ON BRUCELLOSIS

SEPT. 23, 1989

STATEMENT OF OCLERIS SIMPSON, DEAN FOR RESEARCH AND
EXTENSION AND ACTING DIRECTOR OF THE AMERICAN INSTITUTE FOR
GOAT RESEARCH, LANGSTON UNIVERSITY, LANGSTON, OKLAHOMA

ACCOMPANIED BY: MICHAEL POTCHOIBA, PING WU, A.D. SCARFE AND
TILAHUN SAHLU

MR. CHAIRMAN, I AM OCLERIS SIMPSON, DEAN FOR RESEARCH
AND EXTENSION AND ACTING DIRECTOR OF AIGR AT LANGSTON
UNIVERSITY. ON BEHALF OF MY COLLEAGUES, MR. POTCHOIBA, MS.
WU, DR. SCARFE AND SAHLU, WE THANK YOU FOR THE OPPORTUNITY
TO APPEAR BEFORE YOUR SUBCOMMITTEE. TODAY, WE SPEAK ON
BEHALF OF THE UNIVERSITY AND IN SUPPORT OF PRODUCER
ASSOCIATIONS WHO ARE CONCERNED ABOUT BRUCELLOSIS IN GOATS.
I SHALL FIRST DESCRIBE A BIT OF HISTORY ON THE BRUCELLOSIS
PROBLEM.

HISTORY

BRUCELLOSIS-LIKE SYMPTOMS IN HUMANS WERE DESCRIBED AS EARLY
AS 450 B. C. BY HIPPOCRATES. THE FIRST MEDICALLY ACCEPTABLE
AND ACCURATE RECORDING OF BRUCELLOSIS AS A HUMAN DISEASE WAS
PREPARED BY MARSTON IN 1861 AS HE DOCUMENTED THE SYMPTOMS OF
HIS ILLNESS. THE FIRST MAJOR SERIES OF RESEARCH ADVANCEMENT
TOWARDS UNDERSTANDING THE ETIOLOGY OF BRUCELLOSIS WERE THE
INVESTIGATIONS BY DR. DAVID BRUCE. DR. BRUCE WAS ASSIGNED
TO THE VALETTA HOSPITAL AT THE MALTA NAVAL BASE TO CARE FOR

THE MILITARY PERSONNEL STRICKEN WITH MALTA FEVER. THIS FEVER INCAPACITATED LARGE NUMBERS OF MILITARY AND CIVILIAN PERSONNEL WHICH MYSTIFIED DOCTORS FROM CYPRUS, MALTA, AND GILBRALTAR THROUGHOUT THE EIGHTEENTH AND NINETEENTH CENTURIES. UPON HIS ARRIVAL AT MALTA, DR. BRUCE WAS THE FIRST TO CULTIVATE AND ISOLATE THE ETIOLOGICAL BACTERIUM FROM FOUR FATAL CASES OF MALTA FEVER. HE DESIGNATED THIS BACTERIUM MICROCOCCUS MELITENSIS (ACTUALLY KNOWN AS BRUCELLA MELITENSIS) AND RENAMED THE DISEASE MEDITERRANEAN FEVER. (ACTUALLY KNOWN AS BRUCELLOSIS). AFTER BEING TRANSFERRED TO UGANDA, AFRICA, DR. BRUCE IDENTIFIED THE NATIVE DISEASE KNOWN AS MUHINYO AS ACTUALLY BEING BRUCELLOSIS AND THAT THE DISEASE WAS TRANSMISSIBLE FROM GOATS. DR. BRUCE WAS THE FIRST TO ACCURATELY DEFINE BRUCELLOSIS ETIOLOGICALLY.

SURGEON MAJOR M. L. HUGHES INFLUENCED THE INVESTIGATION OF BRUCELLOSIS BOTH POSITIVELY AND NEGATIVELY. HIS HISTORICAL MONOGRAPH OF BRUCELLOSIS EARNED HUGHES HIS PLACE IN HISTORY. HUGHES RECOGNIZED FOUR TYPES OF BRUCELLOSIS IN WHICH HE ONLY DESCRIBED THE MILD FORMS OF THE DISEASE WHILE FAILING TO ACKNOWLEDGE THE PROLONGED SYMPTOMS OF BRUCELLOSIS. MAJOR HUGHES REFERRED TO BRUCELLOSIS AS UNDULANT FEVER WHICH IS STILL IN USE TODAY AND CONTINUES TO CREATE A MISLEADING UNDERSTANDING OF THE DISEASE. ALTHOUGH HUGHES OBSERVED THAT UNDULANT FEVER OCCURRED IN COUNTRIES WHERE GOAT MILK WAS READILY AVAILABLE AND IN FAMILIES WHOSE SOLE SOURCE OF DRINKABLE MILK WAS FROM GOATS, MAJOR HUGHES REJECTED THE IDEA THAT GOAT MILK WAS THE SOURCE OF THE

DISEASE DUE TO THE SANITARY METHODS UTILIZED IN MILKING GOATS. MAJOR HUGHES CONCLUDED THAT THE "VIRUS" MUST ENTER THE HUMAN BODY VIA INSPIRED AIR AND HE ACTUALLY PRESCRIBED GOAT MILK TO PATIENTS SUFFERING FROM BRUCELLOSIS.

WRIGHT AND SMITH REPORTED THE DEVELOPMENT OF A RELIABLE BLOOD AGGULUTINATION TEST WHICH ALLOWED THE DIFFERENTIATION BETWEEN TYPHOID AND MALTA FEVERS. THE ONLY FUNDAMENTAL QUESTION YET TO BE RESOLVED WAS, HOW DID HUMANS BECOME INFECTED WITH BRUCELLOSIS? THIS QUESTION PROMPTED THE FORMATION OF THE MEDITERRANEAN FEVER COMMISSION IN 1904 TO INVESTIGATE THE EPIDEMIOLOGY OF BRUCELLOSIS.

THE ISLE OF MALTA WAS A MAJOR MILITARY INSTALLATION FOR GREAT BRITAIN WHOSE 25,000 SOLDIERS AND SAILORS WERE BEING DEVASTATED WITH BRUCELLOSIS. FROM 1901 THRU 1906 AN AVERAGE OF 302 CASES WITH 7 DEATHS WERE REPORTED ANNUALLY DURING THIS SIX YEAR PERIOD. THE CIVILIAN POPULATION HAD AN ANNUAL AVERAGE OF 652 CASES WITH 68 DEATHS DURING THE SAME PERIOD. DR. T. ZAMMIT REPORTED STRONG AGGLUTINATION REACTIONS FOR MICROCOCCUS MELITENSIS FROM BLOOD SAMPLES WITHDRAWN FROM 5 OF 6 NATIVE GOATS ON MALTA. THIS BRUCELLA BACTERIUM, MICROCOCCUS MELITENSIS, WAS ALSO ISOLATED FROM THE BLOOD OF ONE OF THESE GOATS. AFTER FURTHER INVESTIGATION IT WAS ESTIMATED THAT 40 PERCENT OF THE 20,000 GOATS OF MALTA EXHIBITED POSITIVE REACTION TO THE AGGLUTINATION TEST FOR BRUCELLOSIS. THE RESULTS OF DR. ZAMMIT'S INVESTIGATION DIRECTLY IMPLICATED GOAT MILK AS THE MEDIUM CAUSING HUMAN BRUCELLOSIS. THE MEDITERRANEAN FEVER COMMISSION IN 1906

PROHIBITED THE CONSUMPTION OF UNPASTEURIZED GOAT MILK AND ITS PRODUCTS BY ALL BRITISH MILITARY PERSONNEL AND ELIMINATED THESE PRODUCTS FROM BEING SERVED AT GOVERNMENT ESTABLISHMENTS. ALTHOUGH THE DISEASE CONTINUED TO AFFECT THE CIVILIAN POPULATION IN 1907 AS IN YEARS PAST (714 CASES WITH 78 DEATHS), THE INCIDENCE OF BRUCELLOSIS WAS DRAMATICALLY REDUCED IN MILITARY PERSONNEL (21 CASES WITH 1 DEATH). THIS EVIDENCE CONVINCINGLY DEMONSTRATED THAT THE CONSUMPTION OF UNPASTEURIZED GOAT MILK AND ITS PRODUCTS FROM MICROCOCCUS MELITENSIS INFECTED GOATS CAUSED BRUCELLOSIS IN HUMANS.

CAUSATIVE AGENT

THERE CURRENTLY EXISTS SIX SPECIES OF THE GENUS BRUCELLA THAT CAUSES BRUCELLOSIS. BRUCELLA ABORTUS, BRUCELLA CANIS, BRUCELLA MELITENSIS, BRUCELLA NEOTOMAE, BRUCELLA OVIS, AND BRUCELLA SUI ARE ALL CAPABLE OF CAUSING BRUCELLOSIS UNDER NATURALLY-OCCURRING CONDITIONS WITH SPECIFICITY TOWARDS A PREFERRED HOST. BRUCELLA MELITENSIS APPEARS TO BE THE LEAST HOST SPECIFIC OF THE BRUCELLA. GOATS ARE THE PREFERRED AND PRIMARY HOST OF BRUCELLA MELITENSIS. THE GOAT APPEARS TO BE THE ONLY DOMESTICATED ANIMAL TO BE TOTALLY RESISTANT TO INFECTION BY OTHER BRUCELLA ORGANISMS UNDER NATURALLY OCCURRING CONDITIONS. CAPRINE BRUCELLOSIS DEVELOPS ONLY FROM BRUCELLA MELITENSIS. BRUCELLA MELITENSIS IS CONSIDERED WITHOUT DOUBT TO BE THE

MOST DANGEROUS BRUCELLA SPECIES AND HAS BEEN ISOLATED FROM MOST DOMESTICATED ANIMALS, INCLUDING MAN. CATTLE BECOME INFECTED WITH BRUCELLA MELITENSIS WHEN GRAZING PASTURES COMMON WITH INFECTED GOATS AND SHEEP. BOVINE BRUCELLOSIS ERADICATION PROGRAMS SHOULD CONSIDER BRUCELLA MELITENSIS AS A SERIOUS HUMAN HEALTH RISK SINCE DAIRY COWS ARE CAPABLE OF EXCRETING THIS ORGANISM IN THEIR MILK.

GEOGRAPHICAL DISTRIBUTION

THE MIDDLE EAST (ESPECIALLY IRAN), CENTRAL ASIA (ESPECIALLY NORTHERN CHINA, MONGOLIA, AND RUSSIA), LATIN AMERICA (ESPECIALLY MEXICO AND PERU), AND THE EUROPEAN COUNTRIES WHICH BORDER THE MEDITERRANEAN SEA ARE CONSIDERED TO BE AREAS OF HIGH CAPRINE BRUCELLOSIS PREVALENCE. AFRICA, INDIA, AND VARIOUS REGIONS OF LATIN AMERICA AND SOUTHEAST ASIA PREVAIL AS BEING MODERATELY INFECTED WITH CAPRINE BRUCELLOSIS. THE UNITED STATES, CANADA, AUSTRALIA, JAPAN, NEW ZEALAND, THE PACIFIC ISLANDS, AND EUROPEAN COUNTRIES WHICH EXIST NORTH OF THE ALPS ARE THOUGHT TO BE FREE OF CAPRINE BRUCELLOSIS. ALTHOUGH THE UNITED STATES POPULATION OF GOATS ARE THOUGHT TO BE BRUCELLOSIS FREE, SEVERAL CASES OF HUMAN BRUCELLOSIS HAVE BEEN REPORTED INVOLVING BRUCELLA MELITENSIS.....THE KILLER OF HUMAN BEINGS.

MODE OF TRANSMISSION

AREAS OF THE WORLD WHERE THE INCIDENCE OF BRUCELLOSIS IS OF EPIDEMIC PROPORTIONS IN THE GOAT POPULATION, HUMAN HEALTH PROBLEMS WITH THE DISEASE ALSO EXISTS. BRUCELLOSIS IS AN INFECTIOUS DISEASE AND CONSIDERED A TRUE ZOOZOSIS. BRUCELLA ORGANISMS HAVE BEEN ISOLATED FROM MOST DOMESTICATED ANIMALS AND MAN. BRUCELLOSIS IS NOT INFECTIOUS BETWEEN HUMAN BEINGS. HUMANS CONTACT BRUCELLOSIS WHEN THEY COME INTO CONTACT WITH INFECTED ANIMALS OR CONTAMINATED DAIRY PRODUCTS. THERE EXISTS TWO PRIMARY MODES OF BRUCELLOSIS TRANSMISSION TO HUMANS FROM INFECTED ANIMALS. THE PRINCIPLE MEANS OF TRANSMITTING THE BRUCELLA ORGANISM TO THE GENERAL PUBLIC OCCURS UPON THE CONSUMPTION OF CONTAMINATED MILK OR DAIRY PRODUCTS. VETERINARIANS, HERDSMEN, AND ABATTOIR WORKERS ARE SUSCEPTIBLE TO BRUCELLOSIS INFECTION UPON HANDLING INFECTED FETUSES, PLACENTAS, UTERI, AND UTERINE FLUIDS WHICH HARBOR INNUMERABLE POPULATIONS OF THE BRUCELLA. SIMPLE ACTIONS SUCH AS SMOKING A CIGARETTE AFTER HANDLING AN INFECTED ANIMAL WITHOUT PROPER SANITATION PRECAUTIONS IS CAPABLE OF TRANSMITTING BRUCELLOSIS.

HUMAN HEALTH RISK

BOTH AVENUES OF BRUCELLOSIS TRANSMISSION TO HUMANS ARE OF EQUAL CONCERN THROUGHOUT THE WORLD. DEPENDING ONLY UPON THE LOCALE AND NATIONAL CUSTOMS ONE TRANSMISSION MODE MAY BE

MORE INFLUENTIAL THAN THE OTHER. PEOPLE OF URBAN AREAS ARE MORE LIKELY TO DEVELOP BRUCELLOSIS FROM THE CONSUMPTION OF BRUCELLA INFECTED DAIRY PRODUCTS. CASE STUDIES IN HOUSTON, TEXAS REVEALED THAT 19 OF 31 PATIENTS DEVELOPED BRUCELLOSIS UPON INGESTION OF BRUCELLA MELITENSIS CONTAMINATED CHEESE IMPORTED FROM MEXICO. THE CHEESE WAS PREPARED FROM UNPASTEURIZED GOAT MILK. TWO OUT OF THREE ENGLISHMAN WHILE ON VACATION IN SPAIN DEVELOPED BRUCELLOSIS. ALL THREE INDIVIDUALS CONSUMED MILK, BUT ONLY THE TWO WHO DEVELOPED SYMPTOMS OF BRUCELLOSIS FREQUENTLY CONSUMED CHEESES MADE FROM GOAT MILK. BRUCELLA MELITENSIS WAS BACTERIOLOGICALLY ISOLATED FROM BLOOD SAMPLES WITHDRAWN FROM BOTH PATIENTS. DURING THE PREPARATION OF SOFT CHEESES THE BRUCELLA ARE TRAPPED WITHIN THE CHEESE, WHEREAS THE WHEY IS RELATIVELY FREE OF BRUCELLA ORGANISMS. HARD CHEESES PREPARED FROM BRUCELLA INFECTED MILK APPEAR TO BE LESS OF A RISK TO HUMAN HEALTH BECAUSE THEY MAY BE AGED FOR A PERIOD OF TIME WHICH ALLOWS THE BRUCELLA TO GRADUALLY DIE.

IN RURAL AREAS OF DEVELOPING COUNTRIES, HUMAN BEINGS CONTACT BRUCELLOSIS THRU CLOSE ASSOCIATION WITH INFECTED GOATS DURING THE KIDDING SEASON. STUDIES IN INDIA REVEALED THAT THE MAJORITY OF HUMAN BRUCELLOSIS CASES OCCURRED IN THE FAMILIES OF GOAT SHEPHERDS DURING PERIODS WHEN GOATS ABORTED THAN WHEN BRUCELLA MELITENSIS WAS EXCRETED IN GOAT MILK. THE GOAT HAS ALWAYS BEEN ACKNOWLEDGED AS THE PRIMARY SOURCE OF BRUCELLA MELITENSIS INDUCED BRUCELLOSIS IN HUMANS. GOAT ABORTIONS IN THE EAST AFRICAN COUNTRY OF KENYA WERE FIRST

RECORDED IN 1972, ALTHOUGH HUMAN BRUCELLOSIS RESULTING FROM BRUCELLA MELITENSIS INFECTION HAS BEEN KNOWN SINCE 1953. KENYAN SHEPHERDS USUALLY HOUSE THEIR GOATS WITH THEIR FAMILY. UNDER THESE CONDITIONS, MANY INDIVIDUALS DEVELOPED CAPRINE BRUCELLOSIS BUT DOCTORS HAVE FAILED TO SIMULTANEOUSLY CULTIVATE BRUCELLA ORGANISMS FROM BOTH THE HUMAN PATIENT AND HIS HERD. MONGOLIA RESEARCHERS HAVE BEEN ABLE TO CONFIRM THAT 80% OF HUMAN BRUCELLOSIS CASES WERE CONTRACTED DURING THE KIDDING SEASON. THE ORGANISM THAT THEY IDENTIFIED WAS OF GOAT ORIGIN. ITALIAN INVESTIGATIONS CLEARLY DEMONSTRATED THAT HUMAN BRUCELLA MELITENSIS INFECTIONS CORRELATED WITH PEAK PERIODS OF KIDDING AND AVAILABILITY OF CAPRINE CHEESE PRODUCTS. IN DEVELOPING COUNTRIES WHERE COW MILK IS OF AMPLE SUPPLY AND THE PREFERRED SOURCE OF MILK, GOATS ARE PRIMARILY UTILIZED AS A SOURCE OF MEAT. THE PRIMARY MODE OF BRUCELLOSIS TRANSMISSION WOULD BE FROM HANDLING INFECTED ANIMALS INSTEAD OF CONSUMING INFECTED DAIRY PRODUCTS. REDUCING THE INCIDENCE OF HUMAN BRUCELLOSIS IS NOT SIMPLE, BUT DIRECTLY TIED IN WITH LIVESTOCK ERADICATION PROGRAMS WHICH MUST BE DESIGNED ACCORDING TO NATIVE SOCIOECONOMIC CUSTOMS.

SUMMARY

GOATS ARE THE PRIMARY RESERVOIR OF SPREADING BRUCELLA MELITENSIS AND THIS BACTERIUM IS HIGHLY PATHOGENIC FOR MAN. THE WORLDWIDE INCIDENCE OF BRUCELLA MELITENSIS INDUCED HUMAN

BRUCELLOSIS DIRECTLY COINCIDES WITH INFECTED GOAT POPULATIONS. BRUCELLOSIS IS APPARENTLY THE MOST WIDESPREAD AND DEVASTATING OF THE ZOOSES WITH ITS INCIDENCE INCREASING IN CERTAIN AREAS OF THE WORLD. RECENT INVESTIGATIONS IN AFRICA AND INDIA INDICATES THAT BRUCELLOSIS IN LIVESTOCK AND MAN IS MORE PREVALENT THAN ONCE THOUGHT. FORTY OF THE FORTY-NINE AFRICAN COUNTRIES REPORT LIVESTOCK BRUCELLOSIS WITH 41% CONTAINING A HIGH PREVALENCE. CASES OF HUMAN BRUCELLOSIS HAVE BEEN REPORTED FROM 32 OF THE 49 AFRICAN COUNTRIES. THIS INCREASE OF BRUCELLOSIS INCIDENCE IN AFRICA CAN BE ATTRIBUTED WITH INCREASED DEMANDS IN ANIMAL PRODUCTION WITHOUT THE CORRESPONDING IMPLEMENTATION OF HYGIENIC HUSBANDRY PRACTICES.

THE PASTEURIZATION OF MILK IS ONLY ONE INTEGRAL STEP, BUT A VITAL ONE, TOWARDS REDUCING THE INCIDENCE OF HUMAN BRUCELLOSIS. PEOPLE WHO DO NOT HAVE DIRECT CONTACT WITH INFECTED GOATS OR ASSOCIATION WITH AREAS WHERE INFECTED GOATS ARE PROCESSED, WOULD BE THE ONLY BENEFICIARIES FROM MILK PASTEURIZATION. HERDSMEN AND THEIR FAMILIES, VETERINARIANS, AND ABATTOIR WORKERS WOULD STILL BE POTENTIAL CANDIDATES FOR BRUCELLOSIS INFECTION. IN DEVELOPING COUNTRIES WHERE GOATS ARE ROUTINELY RAISED BY THE MAJORITY OF PEOPLE, BRUCELLOSIS WOULD CONTINUE TO PROPAGATE WITHOUT INSTILLING OTHER MEASURES TO ERADICATE THE DISEASE. LOGISTICAL, SOCIOECONOMICAL, AND TECHNICAL PROBLEMS HAVE BEEN WELL DOCUMENTED SUGGESTING THAT THE ERADICATION OF BRUCELLOSIS IN DEVELOPING COUNTRIES WOULD BE A DIFFICULT

TASK. CITING THE CLASSIC EXAMPLE OF DISEASE REDUCTION ON THE ISLE OF MALTA IN 1907 CLEARLY INDICATES THAT THE GENERAL POPULATION WOULD ADAMANTLY RESIST DRAMATIC CHANGES IN THEIR LIVELIHOODS. THUS INDICATING THAT THE PASTEURIZATION OF MILK ALONE WOULD NOT REDUCE THE INCIDENCE OF HUMAN BRUCELLOSIS.

VACCINATION PROGRAMS DESIGNED TO ERADICATE BRUCELLOSIS FROM THE GOAT POPULATION APPEARS TO BE THE BEST POSSIBLE SOLUTION TO REDUCE EXPOSURE TO MAN IN DEVELOPING COUNTRIES. IN THE MEAN TIME, EDUCATIONAL PROGRAMS MUST BE ESTABLISHED IN THE AREAS OF GOAT HUSBANDRY, HUMAN HYGIENE, SLAUGHTERING TECHNIQUES, AND MILK PASTEURIZATION IN ORDER TO HELP CONTROL THE RISK OF BRUCELLOSIS EXPOSURE TO MAN UNTIL A REDUCTION IN THE INCIDENCE OF BRUCELLOSIS OCCURS IN THE GOAT POPULATION.

MR. CHAIRMAN, WE KNOW THAT THE INCIDENCE OF BRUCELLOSIS IN GOATS IN THE UNITED STATES IS VERY LOW. ALSO, WE KNOW THAT THE GOAT POPULATION IS EXPANDING. THIS MEANS THAT THE PROBABILITY OF CASE FREQUENCIES WILL INCREASE. CONSEQUENTLY, WE FAVOR A CONTINUOUS MONITORING OR SURVEILLANCE PROGRAM AT AMERICAN INSTITUTE FOR GOAT RESEARCH TO ASSURE THAT BRUCELLOSIS IN GOATS IS KEPT IN CHECK RATHER THAN AN INCIDENCE WAITING TO HAPPEN. THE TECHNOLOGY IS AVAILABLE AND INEXPENSIVE FOR A PROGRAM OF MONITORING. IT IS OUR HOPE AND GOAL TO ASSIST YOUR SUB-COMMITTEE IN ANY POSSIBLE WAY.

MR. CHAIRMAN.

By JAMES B. OWEN

First Vice President

Texas and Southwestern Cattle Raisers Association

Chairman Stenholm, members of the subcommittee, fellow panelists and guests, my name is Jimmy Owen. I am pleased to be before this subcommittee today as first vice president of the Texas and Southwestern Cattle Raisers Association. We are a 112-year-old trade association with approximately 14,000 members mostly in Texas and Oklahoma.

Texas cattlemen thank you for convening this oversight hearing on the brucellosis program. You have assembled a group of people recognized for their knowledge of this program. You have given us the opportunity today to speak our piece...to set in motion a rapid acceleration of this program...to eradicate this costly disease from the cattle herds of these two great states and, indeed, the nation. For that, we thank you.

My brief remarks today are shaped by my firsthand knowledge of the disease and the program. My experience has been developed over a lifetime in the cattle business. I am a commercial cow/calf producer in East Texas (the Tyler area). At one time I had cattle that were infected with brucellosis, so I have had firsthand knowledge of both the disease and the program. I also run stocker cattle and feed cattle in commercial feedyards. In addition, I serve as vice chairman of the Texas Animal Health Commission.

With this background, I would like to share with you my views on the brucellosis program. I have four points to make and then I will try to answer any questions you might have.

1. The brucellosis program in Texas had made tremendous strides toward eradication and control in recent years. Since 1979, Texas has made its most substantial progress in brucellosis eradication.

During this decade of progress, we have used our eradication funds

Texas and Southwestern Cattle Raisers Association, a 112-year-old livestock trade organization, represents approximately 14,000 working cattlemen primarily in Texas and Oklahoma. For more information, contact TSCRA, 1301 W. Seventh Street, Fort Worth, Texas 76102-2660 or 817/332-7064.

to increase adjacent testing, acquire the most reliable laboratory equipment, improve the quality and efficiency of our staff and make significant technological advances in our battle against the disease.

The statistics which Dr. Holcombe has already presented are concrete evidence of this progress, so I will not dwell further on this point.

2. Texas cattle producers, for the most part, are cooperative and have a good attitude about the brucellosis program. There is significant evidence among the cattle producers of Texas that they realize the importance of the eradication of brucellosis in our state, if we are to continue to move our cattle freely. It is my opinion they are ready to move ahead and finish the job.

Tangible evidence of this is seen in the fact that Texas now has more than two-thousand two hundred (2,200) certified-free herds. These herd owners test all their cattle once a year at their own expense, even though they have no known disease, just to make certain they are selling clean cattle.

Let me quote from a letter I recently received from one of our members. While this man is writing primarily in support of mandatory vaccination, I think it demonstrates the attitude of Texas cattlemen about moving the program forward.

I quote: "Now, what has happened to our mandatory calfhood vaccination for all females in Texas? It is time that we try again. We cannot, you cannot afford to let Texas be quarantined; not even the eastern third. Let's get the mandatory calfhood vaccination back in place now. Why not this October, 1989?"

And to quote him further: "If inconsistent rules and regulations are a part of our undoing, then let's get consistent."

3. A cut in federal funding for the brucellosis program in Texas could wipe out much of the progress made in recent years. In the fiscal year 1989, in spite of the substantial progress made in the state and the impending October 1990 deadline for all states to reach Class A status, deep federal funding cuts were made in the brucellosis eradication program.

They could not have come at a more inopportune time and have made it increasingly difficult for Texas to maintain its progress. If this funding is not restored to at least the 1988 level, it is my opinion it will be very difficult for us to continue our progress at the present rate.

4. My fourth and final point. Texas cattlemen want congressional support for an accelerated Rapid Completion Plan to eradicate brucellosis. I have attached to my written comments a copy of the Rapid Completion Plan which has the support of both the Texas and Southwestern Cattle Raisers Association and the National Cattlemen's Association.

I will not take time to cover the details of this program today, but I would like to briefly summarize it.

The plan calls for, among other things, an increased use of herd depopulation, increased adjacent and contact herd testing, mandatory whole-herd vaccination for known infected herds and increased training in high-incident states. This plan is designed to achieve free status for all states within five years. I believe this is a viable and achievable goal. In order to implement this program, it will require increased funding particularly in the next three years, but I think a close examination of this plan will show that it is the most effective way to proceed.

I strongly urge that you give the funding of this program very serious consideration.

On behalf of the Texas and Southwestern Cattle Raisers Association, I want to thank you for the opportunity to present our views today. I will be happy to try to answer any questions you might have.

--TSCRA--

(Attachments follow:)

BRUCELLOSIS ERADICATION

Introduction

In February 1989, the National Cattlemen's Association requested that the Animal and Plant Health Inspection Service (APHIS) develop and present an alternative plan for the eradication of brucellosis. In response to that request, in March 1989, APHIS developed the "Plan for the Rapid Completion of Brucellosis Eradication." The plan was provided to stimulate discussion of possible alternatives to the current U.S. Department of Agriculture (USDA) policy on brucellosis eradication, and does not represent USDA policy for this program.

During review of the Rapid Completion Plan, representatives of the livestock industry and the animal health profession expressed concern about the rigidity of the plan's depopulation component. This document, reflecting industry suggestions, presents further clarification and revision of the conditions under which depopulation and whole herd vaccination would be conducted.

Overview of the Plan

In developing an alternative plan for the eradication of brucellosis, it is recognized that with long-established animal diseases the last vestiges of infection are the most difficult and costly to eradicate. A concerted effort is required to locate unobtrusive pockets of infection and provide assurances to stakeholders that full eradication is preferable to an approach that only controls the disease at a low prevalence level.

Objectives

The first objective of the Rapid Completion Plan, to have no brucellosis infected herds under quarantine in 2 years, may not be completely achievable and could conflict with other recommended modifications of the plan. The final objective of all States Class Free or in the qualifying process for Class Free classification in 5 years was considered to be attainable and realistic if the necessary resources can be made available to implement the entire plan. It would require adequate funding, producer cooperation, and aggressive administration at the local, State, and national level. Intermediate objectives to replace the Rapid Completion Plan's first objective are as follows:

1. In 1 year, all identified infected herds in the United States will be on a herd plan which requires whole herd vaccination.
2. In 2 years, all identified infected herds in the current Class A States would be depopulated or whole herd vaccinated.
3. In 3 years, all current Class B and Class C areas would be Class A or Class Free or in the qualifying process for Class Free classification.
4. In 4 years, all States except the current Class B and Class C States, would be Class Free or in the qualifying process for Class Free classification.
5. In 5 years, all States would be Class Free or in the qualifying process for Class Free classification.

Technical Approach

Program experience as well as epidemiologic studies have shown that the following key program elements are essential for achieving rapid eradication in an efficient manner:

1. A surveillance system which is adequate in extent of coverage, sensitivity for detecting, and tracing back to herd of origin, all reactor animals.
2. A whole herd depopulation strategy that is consistently applied and sensitive to fluctuations in market prices.
3. Use of whole herd vaccination to control spread of infection within herds while the infection is being eradicated.
4. Full compliance with standards of the Uniform Methods and Rules (UM&R) for brucellosis eradication.

To provide for the above key elements and achieve the eradication in as short a time as possible, acceleration of selected critical activities within the current brucellosis program operational structure will be required. These accelerated activities include:

- o State program technical reviews.
- o Enhanced First Point Testing.
- o Increased adjacent and contact herd testing.
- o Increased epidemiology testing.
- o Mandatory whole herd vaccination
- o Increased depopulation.
- o Use of local task forces for area testing where required.
- o Increased training in high incidence States.

These accelerated activities must be implemented on a national scale so that problems associated with the movement of animals from adjacent areas or States that harbor infection are addressed at the same time. The operational logic of a rapid eradication program would be as follows:

1. Development of State and national program goals to guide and motivate APHIS, State, and industry personnel;
2. Rigorous technical reviews of individual State programs;
3. Immediate follow-up/reinforcement of State technical review recommendations (e.g. with personnel, training, depopulation funding, equipment) as required;
4. Continual monitoring of program progress through an enhanced surveillance system.

A rapid eradication program will require that, (a) funding and staffing levels are adequate to carry out the depopulation strategy, enhanced surveillance, and other accelerated activities, and (b) the goals of such an effort will provide a credible vehicle for organizing all stakeholders, especially in the high incidence States.

Detailed Discussion of Depopulation and Whole Herd Vaccination Activities

A depopulation based program is the most cost-effective approach to complete eradication of brucellosis and the only way to accomplish that in a short period of time. There are however situations where depopulation may not be the most cost-effective approach either for the herd owner or the brucellosis program as a whole, such as in the case of very large herds, valuable purebred herds, or where adequate separation of an infected herd from uninfected herds exists. In cases like these, use of whole herd vaccination, periodic retesting of infected herds, and culling of reactors may be the preferred management approach.

The discussion which follows presents in greater detail the guidelines for determining when depopulation and whole herd vaccination would be conducted.

Increased Depopulation

1. Increase herd depopulation in all areas of the U.S. with mandatory depopulation in Class Free states.
2. All currently known infected herds may be offered herd depopulation following any subsequent herd retest with reactors.
3. All new infected herds found in which more than 10% of the herd is found to be infected may be offered herd depopulation as soon as field strain infection is confirmed by culture or other epidemiological evidence.
4. Large herds or valuable purebred herds may be offered whole herd vaccination instead of depopulation indemnity if this is agreed to by the State animal health officials, VS Area Veterinarian in Charge, designated epidemiologist in the State, and the regional epidemiologist. The following conditions will be considered in making this decision:
 - a. There is a reasonable expectation that the herd will be free of field strain infection within 1 year and/or be released from quarantine within 2 years.
 - b. An economic analysis shows the costs of testing the herd (including costs to the farmer or rancher) will be substantially less than the costs of depopulation. If continued maintenance of the herd will cause delay in advancement of the State to Class Free status, then the cost to the rest of the livestock industry in the State during the period of expected delay must also be considered.
 - c. There is adequate separation from other herds so that there is reasonable assurance that the infection will not spread to other herds.

- d. The herd owner agrees to adopt herd management practices in a herd plan recommended by their practicing veterinarian, the State or Federal VMO, and the designated epidemiologist in the State, to prevent spread of disease within the herd.
 - e. The herd owner agrees not to add new breeding animals to the infected herd unit until it has had at least one complete negative herd test.
5. Herd owners may be offered whole herd depopulation with incentive indemnity for exposed animals following any subsequent test in which reactors are disclosed even if they have previously declined depopulation.

Mandatory Whole Herd Vaccination

1. Whole herd vaccination will be required in all infected herds that are not depopulated unless vaccinating the adult cattle in the herd would create an economic hardship. In such a case a herd plan must be agreed to by the State animal health officials, VS Area Veterinarian in Charge, designated epidemiologist in the State, and the regional epidemiologist. The following conditions will be considered in making this decision:
 - a. There is a reasonable expectation that the herd will be free of field strain infection within 1 year and/or be released from quarantine within 2 years.
 - b. The herd is a valuable purebred herd with potential international export market which would be lost by vaccination of cattle in the herd.
 - c. There is adequate separation from other herds so that there is reasonable assurance that the infection will not spread to other herds.
 - d. The herd owner agrees to adopt herd management practices in a herd plan recommended by their practicing veterinarian, the State or Federal VMO, and the designated epidemiologist in the State, to prevent spread of disease within the herd.
2. Owners of infected herds who do not vaccinate their whole herd will not receive any indemnity for either initial or subsequent reactors found.
3. Herd owners who own large herds or herds not recommended for depopulation will be expected to vaccinate their whole herd as soon as possible after field strain infection is confirmed in their herd by culture or other epidemiological evidence.

4. Herd owners of herds where initial reactors were not found to be field strain infected by bacteriological culture and other epidemiological evidence may receive reactor indemnity for initial or any subsequent reactors found without whole herd vaccination of their herds.
5. Infected cattle herds may be whole herd vaccinated as an alternative to herd depopulation at either the owner's option when depopulation has been offered or as a State and APHIS-Veterinary Services (VS) option if depopulation is not considered cost effective
 - a. Owner option. Herd owners who choose to vaccinate their herd rather than depopulate their herds when the depopulation option has been offered.
 - o Will be expected to vaccinate their whole herd as soon as possible to be eligible for any indemnity on reactors.
 - o May receive reactor indemnity for any initial or subsequent reactors found in the herd.
 - b. State-VS Option. Herd owners who vaccinate instead of depopulating their herd at the recommendation of the State and VS representatives.
 - o Will be expected to vaccinate their whole herd as soon as possible to be eligible for any indemnity on initial or subsequent reactors.
 - o May receive reactor indemnity for any reactors found on an initial herd test and may receive incentive indemnity for any subsequent reactors found.
6. Management of Whole Herd Vaccinated Herds
 - a. Testing Whole Herd Vaccinated Herds
 - o After whole herd vaccination it is recommended that the herd be retested 60 days after vaccination to establish baseline titers on all cattle in the herd.
 - Use of tests such as the PCFIA with increased sensitivity may be used to identify cattle with potential infection.
 - Within herd segregation of cattle to separate suspicious cattle may be used in large herds.
 - o Herds must be retested 180 days after whole herd vaccination.
 - b. Time limits for clearing whole herd vaccinated herds
 - o Any herd which has not been cleaned up within 2 years following whole herd vaccination will be offered depopulation.

Costs

The Rapid Completion Plan has the lowest amount of average annual cost both to the taxpayers of the various States, the nation, and to the cattle industry, compared to other alternatives examined. Revisions suggested by the industry would not change the essential character of the plan, i.e. achieving complete eradication of the disease in a short period of time, and should result in comparable costs. Lower depopulation costs would be offset, at least in part, by higher testing costs, perhaps over a longer period of time. Precise estimates depend on the management options chosen, aggressive implementation, and other conditions placed on the program.

April 28, 1989

Questions & Answers

BRUCELLOSIS RAPID COMPLETION PLAN

1) What is the Plan?

RESPONSE: An acceleration of U.S. brucellosis eradication efforts to locate and eliminate last pockets of infection.

2) What is the Objective of the Plan?

RESPONSE: To have all States Class Free or in the qualifying process for Class Free classification in 5 years. Currently, the highest brucellosis infection levels are concentrated in 7 Southern States, (Arkansas, Florida, Kentucky, Louisiana, Mississippi, Oklahoma and Texas).

3) Why is the Plan Necessary?

RESPONSE: Unless the plan is implemented, USDA will phase out their involvement beginning in FY 1991 leaving only a "residual program" with funding at approximately \$35 million per year to cover only disease surveillance, reporting and enforcement of interstate regulations. Unless the accelerated program is adequately funded, key elements (depopulation, adult vaccination, secondary surveillance, and calfhood vaccination) for achieving eradication will be lost. Funding will be reduced from \$55.8 million to approximately \$35.9 million in FY 1991. Such a cut will be in addition to the \$10 million cut this past year which has had an adverse impact on program operations. Progress in eradicating brucellosis will suffer, due to a lack of funding.

BUDGET PLAN

In this section, budget breakouts of the plan for the Rapid Completion of the Brucellosis Eradication Program are provided. The Rapid Completion Plan will require funding for both a "core" program that maintains a basic brucellosis program infrastructure of surveillance, prevention, and eradication (e.g. personnel, regular indemnity, testing); and accelerated activities that focus on locating and eliminating infection.

*Plan for the Rapid Completion of the Brucellosis Eradication Program
Budget by Accelerated and Core Activity
(\$ in million)*

<u>Activity</u>	<u>FY 1989</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>
Depopulation	\$ 26.30	\$ 28.70	\$ 24.10	\$ 8.9	\$ 2.30
Training	.04	.12	.08	---	---
Surveillance	3.00	3.26	2.50	1.00	1.00
State Technical Reviews	.08	.08	---	---	---
Task Force Operation	.40	.80	.40	.10	.10
Program Mgmt. & Support	<u>2.42</u>	<u>3.00</u>	<u>2.36</u>	<u>1.60</u>	<u>.54</u>
SUBTOTAL	<u>\$ 32.62</u>	<u>\$ 35.96</u>	<u>\$ 29.44</u>	<u>\$ 11.60</u>	<u>\$ 3.94</u>
CORE PROGRAM	55.80	55.80	55.80	35.00	35.00
TOTAL	<u>\$ 88.42</u>	<u>\$ 91.76</u>	<u>\$ 85.24</u>	<u>\$ 46.60</u>	<u>\$ 38.94</u>

A major goal of the rapid completion plan is to have all identified brucellosis infected herds in the current Class A states depopulated or on whole herd vaccination programs. This goal is projected to be achieved in two years from beginning of program. Projections of new reactor herd detections indicated that within 3 years, the core program can begin to focus on surveillance activities - with a corresponding decrease in cost. Funding for selected accelerated activities will be required after FY 1991 as "residual" infected herds are found and depopulated.

RANDY WARD
REPORT TO
CONGRESSIONAL SUBCOMMITTEE ON
LIVESTOCK, DAIRY & POULTRY

Chairman Stenholm, and distinguished subcommittee, I am Randy Ward, President of the Oklahoma Cattlemen's Association. Brucellosis has been a costly disease over the years to the cattle industry, both in losses of production and tax dollars spent on control.

Oklahoma cattlemen have deep concerns about the brucellosis program and the funding necessary to complete eradication. Many of the tools we have used in the fight against brucellosis have worked well for us. Some examples are, mandatory vaccination and adult vaccination to name a few. Approximately four to five years ago, I came to the conclusion that brucellosis would be nearly impossible to eliminate, however, today there are fewer cases of the disease in Oklahoma than any time I can remember. I think all segments of the industry can now see an end in sight for this disease.

Oklahoma plays an important role in the nation's food chain as one of the larger beef producing states. Over forty-four states have achieved brucellosis free status, but presently, Oklahoma is not one of them. Our state is not only a producer but is also an exporter and importer of beef to other states.

We import cattle from southeast of Oklahoma where infection incidents are higher and we export to northern and western states that are disease free. You can see our problem of the disease free states not wishing to risk reinfection by taking our cattle. Our cattlemen need the supply of cattle from the southeast. Free movement of cattle must continue. Without a doubt, the eradication program must be carried out. The heavy dollars have been spent and the end is in site. Should efforts against this disease be slowed or terminated at this point, reinfection will occur causing disruptions in the supply of beef and great hardship on the Oklahoma and the national cattle industry.

The Governor of Oklahoma has appointed a brucellosis study committee to speed up the bangs free program for Oklahoma. Several gentlemen here today serve on this committee. I have been impressed with the harmony of this committee, with all segments of the cattle industry working toward one goal and unanimously agreeing on a bangs free Oklahoma. This committee feels that the USDA's "Rapid Completion Plan" of mandatory depopulation and/or whole herd vaccination along with adequate funding will deliver the knock-out blow to brucellosis in Oklahoma.

I ask you to make every effort to help make funds available to totally eradicate this disease. Chairman Stenholm and distinguished subcommittee, thank you for holding this hearing in Stillwater. Oklahoma.

STATEMENT OF

BILL BUGG

I am Bill Bugg, a dairyman from Hennessey, Oklahoma. My wife and I operate a family dairy farm, raising purebred Holstein cattle and producing grain and alfalfa. In addition to my farming operation I am a director of Associated Milk Producers, Inc., serve on the Board of Directors of World Dairy Expo, the Oklahoma Dairy Herd Improvement Association and the Oklahoma Holstein Association and serve on the National Dairy Promotion and Research Board.

I appreciate the opportunity to comment on the need for adequate funding to implement the Rapid Completion Plan for Brucellosis eradication. After years of effort, a good deal of trial and error, we are approaching the point where elimination of this disease as a threat to human and animal health is in sight.

Today, there are fewer than 2,400 herds in the U.S. infected with brucellosis. Twenty-nine states have been classed as free of the disease. The challenge is to move forward with actions that will extend this status to all states.

The progress made over the past ten years is an outstanding example of what can be done through cooperative efforts between all sectors of the industry, state and federal governments. Ten years ago, we were losing ground in the fight against Brucellosis. There was a good deal of disagreement within the livestock industry and between the industry and government as to how to deal with the problem. Many even questioned the very idea of eradication.

The work of the National Brucellosis Technical Commission was the starting point of the turnaround. Steady progress has been made in implementing the Commission's recommendations and we are now, so to speak, in the home stretch. A plan designed jointly by industry and government has outlined a five year program that will place us in the position where all states would be Brucellosis free or in the process of being elevated to that classification by the end of that time.

This would remove a constant source of concern for me as a dairyman. It would eliminate a public health hazard which once was among the worst facing the nation. It would complete long years of effort to reach our goal.

I urge Congress to extend the necessary support to these efforts, including the needed funding, so that this work will proceed on schedule.

STATEMENT OF
JOHN MCCROSKEY

I am John McCroskey, a dairy farmer from here in Stillwater, Oklahoma. I have been active in dairy industry activities throughout my career and currently serve on the Board of Directors of the Southern Region of Associated Milk Producers, Inc. and on the Board of AMPI's Oklahoma Division.

We appreciate your interest in and concern over the need to finally defeat a disease that has been a constant problem and concern to the dairyman and a threat to public health. The Rapid Completion Plan for Brucellosis eradication will, if fully implemented, provide the tools to effectively eliminate the disease within five years.

We have reached this point because of the willingness of farmers and ranchers to work together and with government in the development of a program that will work. Just as important, we are at this point because of the leadership of Congressmen like Wes Watkins who have taken the lead in assuring adequate funding for the program and then following up to assure the program was effectively implemented.

The Rapid Completion Plan would concentrate added resources on identification of the remaining points of infection, herd depopulation where needed to remove reactors and prevent spread of the disease, and vaccination to prevent spread and reinfection. To carry out the plan within the five year time frame means an increase in all of the major areas of activity--testing, depopulation and vaccination.

There have been instances in the past when we have lost ground in the fight to eliminate Brucellosis when efforts were relaxed due to budget or personnel limitations. These have, in the long run, cost us more and made the task more difficult. This is a mistake that must be avoided. We must use the present opportunity to write a successful conclusion to a long, difficult battle. A wide range of individuals and organization representing dairy and beef producers have endorsed the Rapid Completion Plan and urged its full implementation. I join in this request and urge you full support for the program.

Hearing on the
Brucellosis Eradication Program
House Subcommittee on Livestock, Dairy and Poultry
Stillwater, Oklahoma
September 23, 1989

Statement Submitted By
The Livestock Marketing Association
of Kansas City, Missouri
and
Mr. Kenneth Sherrill
McAlester Union Livestock Marketing, Inc.
McAlester, Oklahoma

Mr. Chairman, I am Kenneth Sherrill the owner and operator of McAlester Union Livestock Marketing, Inc. of McAlester, Oklahoma. I appreciate the opportunity to appear before the Subcommittee today to express the views of the Livestock Marketing Association (LMA) as well as my own on the subject of the Brucellosis Eradication Program.

LMA, headquartered in Kansas City, Missouri, is the national trade association for livestock marketing businesses. Its nearly 1,300 members across the United States and Canada include livestock auction markets, livestock dealer/brokers, commission companies, marketing cooperatives, transporters, stockyard companies, feedlots and financial institutions.

As members of this committee are well aware, brucellosis is an animal disease of great economic significance to the cattle and dairy industries; its related agriculture industries, such as our marketing businesses; and the consumer. Brucellosis requires the producer to expend millions of dollars every year on testing and prevention practices. Related agricultural industries, such as the marketing sector, incur losses from reductions in sales and the economic burden of meeting varying health standards and requirements in assuring the disease is not passed on through trade channels. The consumer also shares the economic burden through increased prices and reduced supplies of meat and milk.

The marketing sector, along with the cattlemen, state and federal animal health officials and members of this Subcommittee, wishes to see the complete eradication of brucellosis from the nation's cattle herd. How we attain that goal however has been at times a matter of some disagreement within the livestock industry as well as within our own marketing ranks. Nevertheless, there is one thing on which I'm sure we can all agree and that is that a great deal of effort, time and expense already has gone into the brucellosis eradication program and it is now time to bring the program to its full completion.

The brucellosis eradication program has come a long way from its inception nearly 35 years ago. Once the industry and state and federal animal health officials came together in a true cooperative effort in 1954, we began to see steady progress toward eradication of the disease. Today, there are 29 "free" states, 18 "A" states, 6 "B" states. These numbers represent fewer than 2,400 identified infected herds, with the highest brucellosis infection levels concentrated in 6 southern states, including my home State of Oklahoma.

Even though the eradication program's successes have been considerable to date, its future is being threatened by a loss of necessary federal involvement. At this stage in the program, we should be vigorously working to stamp out the last pockets of brucellosis infection rather than abandoning the program at the very point at which a successful conclusion is in sight.

The recent announcement by the Australian government that brucellosis has been eradicated in that country should give us all extra incentive to complete that same mission here in our country. If we fail to rid the U. S. animal population of these serious diseases, we could be seriously jeopardizing our competitive position in the world market.

LMA believes the best answer to addressing the challenge of finally eradicating brucellosis in the United States is adoption of the rapid completion plan developed by the Animal and Plant Health Inspection Service (APHIS) at the request of the National Cattleman's Association. The plan, as revised and adopted by the Ad Hoc Committee on Brucellosis Eradication, of which LMA is a member, clearly recognizes that the last stages of eradication are often the most costly as well as the most difficult to achieve. However, the plan's emphasis on increased depopulation, state program technical reviews, enhanced first point testing and increased adjacent and contact herd testing is in our opinion the most cost beneficial means to bring about rapid and effective eradication of brucellosis in the United States.

As an industry, we cannot expect the American people to continue to expend millions of dollars on a program which has no end in sight. With the rapid completion plan, however, we can achieve a successful end to this program. Thus, LMA joins with other major livestock groups in supporting the funding and implementation of the rapid completion plan and pledge our total cooperation in getting the job done.

That completes my formal statement on behalf of the Livestock Marketing Association, Mr. Chairman.

TECHNICAL OVERVIEW
SOCIOECONOMIC ISSUES IN BRUCELLOSIS ERADICATION

by

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A number of persons made significant contributions to this study and its reporting. James Horne, Vice President for Agriculture, and Brian Espe, Consulting Veterinarian -- both with the Kerr Foundation, Poteau, Oklahoma; and Frank Baker, Coordinator, National Programs, Winrock International, Morrilton, Arkansas, provided guidance, suggestions, and support throughout the project. Also providing valuable assistance at various stages of the project were Gary Lawrence, Elizabeth Speake, and Gary Crosthwait, the Kerr Foundation; Jo Ann Pryor and Mason E. Miller, Winrock International; and Howard P. Peterson, Animal Science Department, University of Arkansas.

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FOREWORD

Although there have been long-term federal and state programs aimed at eradicating the disease, brucellosis is still very much a problem in the United States. There are ways to reduce and eradicate the disease, but still the problem remains.

The Agricultural Division of the Oklahoma-based Kerr Foundation has been conducting campaigns and programs to eradicate brucellosis. Under a U.S. Department of Agriculture grant, it has an educational brucellosis eradication campaign under way in Oklahoma, Arkansas, eastern Texas, and northwestern Louisiana. This region has only 1.3% of the cattle herds in the United States. Yet it accounts for 9.5% of the known brucellosis-infected herds.

The Kerr Foundation has become a major source of information about brucellosis and its eradication. Research testing of new vaccine strains has been conducted using the foundation's facilities. A series of newsletters to farmers, veterinarians, and agricultural lenders has been started. A factsheet series and other educational materials have been produced to help people learn about the disease and how to prevent it.

A survey team from the Agricultural Division of the Kerr Foundation, joined with Winrock International of Arkansas and the University of Arkansas at Fayetteville to carry out a study to find out more about farmers' practices and beliefs in relation to brucellosis, to see if that information would suggest reasons for the failure to eradicate the disease, and ways of eradicating it in this part of the country.

This technical overview is the report of highlights from that study conducted in Oklahoma and Arkansas. While both states follow the federal guidelines that specify calfhoo vaccination, herd testing, quarantine of infected herds, and sales regulation, including some

provision for indemnity to owners of condemned cattle, each state has implemented and enforced the program somewhat differently.

In Oklahoma, private veterinarians have been doing the vaccinating and there have been continuing efforts to eradicate the disease. In Arkansas, public employees have been available to do the vaccinating.



Study area.

TECHNICAL OVERVIEW
SOCIOECONOMIC ISSUES IN BRUCELLOSIS ERADICATION

This is a technical overview of a brucellosis study conducted by the University of Arkansas, the Kerr Foundation, and Winrock International. The survey was based on a random sample of livestock producers in five counties of eastern Oklahoma and five counties of western Arkansas. The authors wanted to determine the relevant characteristics of producers, to describe producers' experiences with the brucellosis program, and to obtain information useful in designing strategies for communicating with them about brucellosis-prevention practices.

The main report provides detailed reference tables on the topics summarized here and later may include specialized studies that examine the characteristics of users of particular media, etc.

This report includes a brief summary of findings, the background of the study, and a summary description of the livestock producers interviewed. This is followed by a description of the characteristics of the producers. They are grouped by 1) those who do not vaccinate, 2) those who do vaccinate and have had no experience with quarantine and, consequently, may be said to vaccinate voluntarily, and 3) those who vaccinate and have been quarantined.¹ A wide variety of producer characteristics are then summarized separately for producers in the two states.

Then, quarantine experience and current status are examined to identify the characteristics of those who are currently quarantined, as well as to determine the characteristics of those who have infected herds. Producer use of information sources is studied as well as the implications this may have for targeting communications about brucellosis. Finally, information concerning producer experiences with quarantine are presented.

¹ We refer throughout the study to on-farm vaccination done at the farmer's initiative, and not that done at the sale barn.

SUMMARY OF THE FINDINGS OF THE STUDY

The livestock producers studied have relatively small herds. A large percentage have off-farm jobs. Their dependence upon livestock income and other farm income is, on the average, relatively low, as is their level of management. For example, there is little systematic record-keeping: 39% keep performance records of their mother cows, 48% record calf birthdates, and 12% keep no financial records.

The characteristics of producers who do not use recommended brucellosis prevention practices provide few surprises. Many owners of smaller herds, the authors discovered, fail to vaccinate their calves. The one surprise is that small herd owners are not the unequivocal culprits. Generally speaking, in the two states, small producers are less likely to vaccinate but many of them who do, vaccinate voluntarily.

The study focuses on the vaccination of calves, which is the major brucellosis control practice available to producers. Calfhood vaccination is practiced by all of the owners of the few large herds (more than 200 animals) because they are more frequently threatened with, or much more frequently subjected to, quarantine.

Since there are very few large herds in the area, efforts to increase compliance with a brucellosis vaccination program must focus upon small-herd owners. Because of their numbers and because of their less frequent contact with the program, efforts to increase compliance must emphasize voluntary compliance.

In both states those who do not vaccinate usually have poorer facilities for penning and working their cattle and have lower levels of herd management (recordkeeping and general health and marketing practices) than those who vaccinate. They also have lower incomes and are less involved in organizations.

Those who vaccinate voluntarily tend to have small herds, to be younger, to have higher levels of management in general, and to be somewhat more knowledgeable about brucellosis. When herd size and type are controlled, those who vaccinate are less likely to be quarantined. These various characteristics differ substantially between the two states.

The characteristics of quarantined producers also differ between the two states. In general, those who vaccinate are at least as likely to be quarantined as those who do not vaccinate. However, this is the result of other variables, like herd size -- where the larger the herd, the higher the probability of being quarantined and of vaccinating.

In Arkansas those who are quarantined receive more of their income from "other" farm sources, primarily poultry production. In both states those who are quarantined use lower levels of financial management and recordkeeping, are older, and have raised livestock for a longer time.

Producers report they depend heavily upon farm magazines for information about animal health and brucellosis. They also depend heavily upon private veterinarians and, in Arkansas, upon the Cooperative Extension Service. Magazines appear to have special potential for persuading producers to use recommended animal health practices. Many farmers who don't vaccinate report that they read farm magazines and have confidence in them.

About 36% of the producers interviewed had had their herds quarantined or were quarantined at the time of the survey. The major problem they had with quarantine was the inconvenience. Most producers said that quarantine had caused them to vaccinate all their cattle and to buy additional animals more carefully. After being quarantined, options available to them had been adequately explained by the officials responsible for the quarantine.

Most producers felt that brucellosis infection rates had declined in the last 5 years, especially in Oklahoma.

The full report provides extensive details of the survey.

BACKGROUND OF THE STUDY

In the past few years, brucellosis has become an increasingly important disease, responsible for significant economic losses to the livestock industry in Arkansas, Oklahoma, Louisiana, and parts of Texas. There is a renewed interest among public and private institutions -- and among producers themselves -- to develop strategies for more effective control. Experts believe that, if the disease is to be controlled, innovative strategies will have to be developed to inform livestock producers about the disease and to persuade them to comply voluntarily with the control program. The development of these strategies requires information about the social and economic characteristics of livestock producers who do not currently comply with the program.

The objectives of this study are to 1) ascertain the characteristics of livestock producers who are not complying with the brucellosis program, 2) describe producer experiences with the brucellosis program, and 3) obtain specific information helpful in designing communication strategies concerning brucellosis control and prevention.

A multidisciplinary team, including a veterinarian, an animal scientist, two agricultural economists, two communications specialists, and one rural sociologist, planned and supervised the study. The team met first for a workshop on the brucellosis "problem." This was followed by an exploratory survey. The team divided into two groups, and each group spent a day carrying out in-depth interviews with livestock producers to better understand their brucellosis management practices and their experiences with and attitudes toward the brucellosis program.

A draft questionnaire was prepared and pretested.² The questionnaire included, in addition to basic questions about brucellosis vaccination practices and quarantine experiences, questions about twelve different subjects:

1. Type and size of livestock operation
2. Facilities for penning and working cattle
3. Herd management practices
4. Recordkeeping and financial management practices
5. Animal health practices
6. Marketing practices
7. Personal characteristics of livestock producers
8. Organizational membership and participation
9. Sources of information about animal health
10. Publications read by producers
11. Agricultural background and educational experiences
12. Response to "brucellosis knowledge test"

Some questions were combined to form scales -- for example, scales of "facilities," "animal health practices," "marketing practices," and "financial management and recordkeeping practices." The scales were created by assigning a value of 1 to each item to which the producer responded positively. The number of items considered varied from scale to scale.

Interviews were obtained by one interviewer from 200 livestock producers -- 100 in Oklahoma and 100 in Arkansas. The interviews were performed in five counties in each state: Bryan, Choctaw, LeFlore, McCurtain, and Pushmataha in Oklahoma; and Hempstead, Polk, Scott, Sevier, and Yell in Arkansas.³ These counties represent areas where brucellosis infection rates have recently been high. Producers were sampled randomly, using a

² Copies of the questionnaire will be supplied upon request.

³ See map at beginning of publication.

modified area probability technique. All interviews were obtained in the spring of 1984 by the same interviewer.

The survey sample differed somewhat from the characteristics of livestock producers reported by the 1982 Census of Agriculture -- too many large producers were interviewed to match the proportions of large and small producers in the census. Consequently, adjustments were made on the basis of herd size to represent the actual population of producers as closely as possible. According to the 1982 Census of Agriculture, there were at that time about 5,200 livestock producers in the five counties surveyed in Oklahoma and about 3,200 in the five counties surveyed in Arkansas. Thus, each sample livestock producer in Oklahoma represents about 52 producers; in Arkansas each represents 32; or overall each producer represents an average of 42 producers.

The survey sample, adjusted in this way, more accurately represents the population of the livestock producers in the 10 counties.

DESCRIPTION OF LIVESTOCK PRODUCERS IN THE STUDY AREA

Table 1.1 describes the type and size of the producers' herds by state.⁴ Producers who had registered animals, or who reported that their major herd⁵ was purebred, were classified as "improved." The remaining herds were classified according to the size of the herd in January 1984.

⁴ The 1982 Census of Agriculture was used to determine the study's distribution of herd size. Since the Census usually has a significant undercount of small producers, the survey probably underestimated the proportion of small producers.

⁵ Answers to a question about the "type" of herd the producer had turned out to be very complex. Many had several different herds. Thus, "type" became arbitrary.

Table 1.1. Herds by type and size in Oklahoma and Arkansas.

	State					
	Oklahoma		Arkansas		Total	
	N	%	N	%	N	%
Type and size of herds						
Unimproved						
Less than 40	53	56	48	49	101	52
40 to 99	22	24	29	30	51	27
100 to 199	11	12	5	5	16	8
200 and more	3	3	2	2	5	3
Improved	6	6	13	13	19	10
Total	95 ^a	100	97	100	192	100

^a Columns do not add up exactly to the totals because of rounding off and weighting procedures.

More than half of the producers have herds with fewer than 40 cattle -- a few more in Oklahoma (56%) than in Arkansas (49%). About 10% report having "improved" herds -- 6% in Oklahoma and 13% in Arkansas.

There are other important characteristics of these livestock producers:

Breeds. The breeds reported are about equally distributed among Angus (19%), Brahman (20%), and Hereford (21%). Another 7% reported Brangus, and a wide variety of breeds represent 15% of the total. Mixed breeds are reported by 18%. Angus and Brahman are reported more frequently in Oklahoma, and Brangus and Hereford more frequently in Arkansas.

Off-farm employment. Forty-one percent of the producers sampled (40% for Oklahoma and 42% for Arkansas) have off-farm jobs. Most of these off-farm jobs are full-time (78%).

Poultry production. Nineteen percent of the livestock producers raise poultry, but most of these producers are in Arkansas. Thirty-three percent of the Arkansas producers who have livestock operations also raise poultry, but only 5% of the Oklahoma livestock producers report raising poultry.

Dependence upon income from cattle and other farm work. Overall, only 30% of the producers' total family income comes from farming -- 15% from cattle production and another 15% from other farm enterprises. In Oklahoma, livestock production is somewhat more important; in Arkansas the emphasis is on other farm enterprises. Arkansas producers generally depend more heavily upon farm income (36%) than do Oklahoma producers (21%).

Age. The average age of producers is 54, and they have been involved in livestock production an average of 25 years.

Management practices. Management practices of many producers appear to be rather casual -- 23% use seasonal breeding, 4% use artificial insemination, 39% keep performance records on their animals, and 48% record birthdates.

Membership in organizations. Membership of livestock producers in organizations is low. An average 46% (54% in Oklahoma and 38% in Arkansas) report that they do not belong to farm-related organizations. In Arkansas, however, 57% of the producers belong to the Farm Bureau and 18% belong to the Arkansas Cattlemen's Association. In Oklahoma, 20% belong to the Farmers Union, 14% to the Oklahoma Cattlemen's Association, and 11% to the Farm Bureau.

Media use. The most popular farm magazine is the *Progressive Farmer*, read by 54% in both states.⁶ Fifty-two percent of Oklahoma producers

⁶ This sample represents more than 4,500 livestock producers in the study counties who are estimated to read the *Progressive Farmer* -- 2,800 in the Oklahoma counties and 1,700 in the Arkansas counties. About 25% of those in Oklahoma (700 producers) and 49% in Arkansas (830 producers) do not currently vaccinate their calves for brucellosis. This overall rate of nonvaccination among *Progressive Farmer* readers (34%), although lower than the rate of nonvaccination among those who do not read that magazine, still isolates a very significant target audience that this magazine can reach. Similar target audiences also have been identified for other media and organization memberships.

also read the *Farmer-Stockman*, 20% read the *Farm Journal*, and 11% read breed magazines. In Arkansas, after *Progressive Farmer*, 33% read Farm Bureau publications, 22% read the *Farm Journal*, and 11% each read *Beef* and breed magazines.

PRODUCER ANIMAL HEALTH PRACTICES AND EXPERIENCE WITH BRUCELLOSIS PROGRAM

Producers were asked, "Are you currently vaccinating your calves for brucellosis?" From the answers a simple classification was created: "vaccinate now but not in the past," "vaccinate now and in the past," or "do not vaccinate." The distribution by state is presented in table 1.2.

Table 1.2. Number and percentage of producers in Oklahoma and Arkansas who vaccinate their calves for brucellosis.

Calfhood vaccination practice	State					
	Oklahoma		Arkansas		Total	
	N	%	N	%	N	%
Vaccinate now but not in the past	61	64	35	36	96	50
Vaccinate now and in the past	18	19	14	15	32	16
Do not vaccinate	<u>17</u>	<u>18</u>	<u>48</u>	<u>49</u>	<u>65</u>	<u>34</u>
Total	96	100 ^a	97	100	193	100

^a Columns may not add up to exactly the totals because of rounding off and weighting procedures.

Overall, 50% vaccinate now but did not do so in the past, 16% vaccinate now and have vaccinated in the past, and 34% do not vaccinate. The figures for the states differ substantially: for Oklahoma -- 64%, now and past; 19%, now; and 18%, do not; and for Arkansas -- 36%, now and past; 15%, now; and 49%, do not.

Producers were also asked about their experience with quarantine. They could respond that they "have never been quarantined," "have been quarantined in the past," or are "now quarantined." Overall, 62% have never been quarantined, 21% have been quarantined in the past, and 17% are now in quarantine. The figures for Oklahoma are 61%, 20%, and 18%; and for Arkansas -- 63%, 22%, and 15%.⁷

Table 1.3 presents the experience of producers with brucellosis quarantine as related to their practice of vaccinating calves -- first for both states combined and then for each state.

Table 1.3. Brucellosis quarantine experience of herds in Oklahoma and Arkansas as related to vaccination of calves.

Quarantine experience	Vaccination practice							
	Now and past		Now, not past		None		Total	
	N	%	N	%	N	%	N	%
Both states								
Never quarantined	61 ^a	51	53 ^a	56	51	80	121	62
Quarantined in the past	12 ^b	37	18 ^b	19	9	14	39	21
Quarantined now	4 ^a	12	24 ^b	25	4	6	32	17
Total	77	100	96	100	64	100	192	100
Oklahoma								
Never quarantined	9	51	39	65	12	70	61	63
Quarantined in the past	7	41	8	13	3	15	18	19
Quarantined now	1	7	13	22	2	14	17	18
Total	18	100	61	100	17	100	96	100
Arkansas								
Never quarantined	7	51	14	39	39	84	60	63
Quarantined in the past	4	31	10	30	6	14	21	22
Quarantined now	3	18	11	31	1	3	15	15
Total	14	100	35	100	47	100	96	100

^a These producers vaccinate calves voluntarily.

^b These producers may vaccinate because of their experience with quarantine.

Note: Columns may not add up to exactly the totals because of rounding off and weighting procedures.

⁷ Because additional samples were selected to ensure obtaining interviews from at least five quarantined producers in each study county, the proportion quarantined is somewhat overestimated in Oklahoma.

One would expect that vaccinating calves would prevent infection and, consequently, being quarantined. Unfortunately, the data in table 1.3 contradict this simple logic. Eighty-one percent of those who have never vaccinated have also never been quarantined. And neither of the groups that has been vaccinating calves has been nearly this effective in avoiding quarantine. Why?

Owners of small herds are less likely to vaccinate and less likely to have their herds quarantined, simply because of herd size. They market less frequently and consequently have less exposure to detection if their animals are infected. Their herds may also be exposed to infection less frequently. However, it is also possible that some of those producers who have had experience with quarantine now vaccinate because of quarantine. This would result in the apparently reverse relationship from that found in table 1.3 and means that producers who vaccinate because of past experience with quarantine are somewhat different from those who vaccinate voluntarily.

TYPICAL CHARACTERISTICS OF 1) PRODUCERS WHO DO NOT VACCINATE FOR BRUCELLOSIS AND 2) PRODUCERS WHO VACCINATE VOLUNTARILY

A variety of things may influence producers to vaccinate or not to vaccinate their calves for brucellosis. The most important influence is the brucellosis program itself, which differs in the two states. Thus, one might expect the state differences (table 1.2) where 18% do not vaccinate in Oklahoma and 49% do not vaccinate in Arkansas.⁸ The differences can probably be attributed to the differences in the brucellosis program in the two states.

⁸ A different survey performed in Yell and Logan counties of Arkansas in 1980 showed about 93% were not vaccinating. Thus, even the 49% not vaccinating in the current study is a very significant reduction.

For producers with very small herds, or producers whose farm income is a very small proportion of total family income, livestock production may not be important enough to justify the inconvenience and associated expense of vaccinating. For some who do not have good penning and working facilities, or for those with very large herds running in "range" conditions, this inconvenience may be considerable. Other producers may decide it is not beneficial to vaccinate because of the low probability that they may be detected and quarantined and because of the low economic loss when reactor cattle are detected. Some producers are reluctant to vaccinate because of uncertainty about the effectiveness of the brucellosis program and about vaccination in particular. Finally, lack of knowledge about the disease and its possible effects may also contribute to the number of producers who do not vaccinate.

Tables 1.5.1 and 1.5.2 and 1.6 and 1.7 provide a comprehensive summary of the unique characteristics of those who do not vaccinate and those who vaccinate voluntarily. Tables 1.5.1 and 1.5.2 present averages or percentages of a wide range of producer characteristics for 1) those who vaccinate voluntarily, 2) those who vaccinate perhaps because of quarantine, 3) those who do not vaccinate, and 4) the total group.

Table 1.4 shows the distribution of vaccination practices by size and type of herd for both states combined and for each state separately. It shows a clear association, as could be expected, between herd size and type, and calfhood vaccination.

Among owners of herds in Arkansas with 200 animals or more, all vaccinate. In Oklahoma the highest rate of nonvaccination (22%) occurred among producers with the smallest herds (less than 40 animals) compared with 18% overall. In Arkansas, the highest nonvaccination rate (64%) occurred among producers with herds of 40 to 99 animals compared with an overall nonvaccination rate of 49%.

Table 1.4. Percentage distribution of type and size of herd by vaccination status.

Type and size of herd	Vaccination status		
	Own Will, %	Because quarantine, %	Don't, %
<u>Both states</u>			
Less than 40	47	15	39*
40 to 99	19	37	44
100 to 199	39	52	8
200 and more	21	79	0
Improved	<u>39</u>	<u>43</u>	<u>18</u>
Total	37	28	34
<u>Oklahoma</u>			
Less than 40	69	9	22
40 to 99	27	55	17
100 to 199	31	59	10
200 and more	21	79	0
Improved	<u>47</u>	<u>40</u>	<u>14</u>
Total	52	30	18
<u>Arkansas</u>			
Less than 40	25	20	55
40 to 99	12	23	64
100 to 199	54	36	10
200 and more	20	80	0
Improved	<u>36</u>	<u>44</u>	<u>20</u>
Total	24	26	49

*Rows do not always add up to 100% because of rounding.

Although those with small herds are more likely not to vaccinate, they are, ironically, also more likely to vaccinate voluntarily (table 1.4). Thus, it is clear that small-herd owners are not the unequivocal culprits when it comes to the control of brucellosis. For both states combined, 47% of those with herds of fewer than 40 animals vaccinate voluntarily, compared with 37% of all herd sizes. For both states combined, only 15% of the smallest herd-size group vaccinates involuntarily because of quarantine, whereas 79% of the largest group (200 animals or more) vaccinates involuntarily because of quarantine, as compared with only 43% of those with "improved" herds.

Table 1.5.1. Characteristics of livestock producers in Oklahoma by calf-vaccination practices.

Producer characteristics	Vaccination practice			For total sample
	Voluntary	Because of quarantine	Do not vaccinate	
Number of cases	50	29	17	96
Av. herd size	43.5*	132.7	32.9*	58.5**
Herd type, % improved	5	8	4	6
Raise poultry, %	5	5	4	5
Off-farm employment, %	44	29	44	40
Percentage income from cattle, avg	11.8*	21.2	19.0	15.9**
Percentage income from other farm sources, avg	3.4	7.5	3.8	4.7
Facilities scale, avg	3.7	3.8	2.5*	3.5**
Management and record scale, avg	1.4*	0.8	0.6*	1.1**
Health practices scale, avg	2.7	2.7	2.7	2.7
Marketing practices scale, avg	0.7*	0.6	0.2*	0.6**
Age of producer, avg	52.6*	60.2	59.1*	56.0**
Years raised cattle, avg	20.5*	34.0	29.9	24.8**
Years of schooling, avg	11.6	13.1	11.5*	12.0**
Completed high school or college, %	58	72	53	61
Total family income, avg (in \$1,000)	19.9	25.7	13.5*	22.3**
Producers with health problems, %	19	28	23	22
Scale of spouse involvement, avg	1.0*	0.6	0.6*	0.8*
Scale of memberships, avg	0.5	0.6	0.1*	0.5**
Farm Bureau memberships, %	13	9	9	11
Scale of brucellosis knowledge, avg	3.3	3.9	3.5	3.5
Scale of agriculture training, avg	0.8	0.8	0.7	0.8
4-H member, %	21	35	19	25

Note: Asterisks indicate that variables are important. Those attached to the right (total) column indicate differences among all three of the other columns. Those attached to the "voluntary" and "do not vaccinate" columns indicate that these are different from all of the rest. In general * means significant at the .10 level and ** means significant at the .05 level; however, multiple criteria -- including the results of the discriminant analysis reported in the body of the report -- are used so that judgment is involved.

Table 1.5.2. Characteristics of livestock producers in Arkansas by calf-vaccination practices.

Producer characteristics	Vaccination practice			For total sample
	Voluntary	Because of quarantine	Do not vaccinate	
Number of cases	24	26	48	97
Av. herd size	58.1	89.1	37.6*	56.9**
Herd type, % improved	20	22	5*	13*
Raise poultry, %	24	37	36	33
Off-farm employment, %	43	30	48	42
Percentage income from cattle, avg	14.1	24.6	6.5*	13.3**
Percentage income from other farm sources, avg	20.6	23.8	20.3	21.5
Facilities scale, avg	3.7	4.1	3.2*	3.6**
Management and record scale, avg	1.3	1.4	2.6*	1.2*
Health practices scale, avg	2.7*	2.8	1.8*	2.3**
Marketing practices scale, avg	0.4	0.7	0.3*	0.4*
Age of producer, avg	51.7	54.6	53.4	53.5
Years raised cattle, avg	23.8	28.6	22.5	23.9
Years of schooling, avg	11.4	11.1	11.2	11.2
Completed high school or college, %	69	62	55	60
Total family income, avg (in \$1,000)	15.5	15.5	17.8	16.7
Producers with health problems, %	15	10	10	11
Scale of spouse involvement, avg	1.1	1.3	0.9*	1.0*
Scale of memberships, avg	0.5*	0.4	0.2*	0.3*
Farm Bureau membership, %	54	56	58	57
Scale of brucellosis knowledge, avg	3.7	4.1	2.3*	3.1**
Scale of agriculture training, avg	0.9	0.7	1.2	1.0
4-H member, %	28	35	17	24

Note: Asterisks indicate that variables are important. Those attached to the right (total) column indicate differences among all three of the other columns. Those attached to the "voluntary" and "do not vaccinate" columns indicate that these are different from all of the rest. In general * means significant at the .10 level and ** means significant at the .05 level; however, multiple criteria -- including the results of the discriminant analysis reported in the body of the report -- are used so that judgment is involved.

Producers Who Do Not Vaccinate

The size of the herd appears to affect whether or not a producer decides to vaccinate (table 1.6). The study shows that small-herd owners are less likely to vaccinate calves than owners of larger herds. The average herd size for producers who do not vaccinate is 32.9 head in Oklahoma and 37.6 head in Arkansas, compared with overall average herd sizes of 68.5 head and 56.9 head in Oklahoma and Arkansas, respectively. Although the differences in the averages appear to be greater in Oklahoma, size differences are more important in Arkansas than in Oklahoma.

Table 1.6. Summary of significant differences in characteristics between producers who do not vaccinate for brucellosis and those who do in Oklahoma and Arkansas (derived from tables 1.5.1 and 1.5.2).

Producer characteristics ^a	Oklahoma		Arkansas	
	Don't vacc.	Do vacc.	Don't vacc.	Do vacc.
Herd size	33	76	38	74
Herd type, % improved	*	*	5	21
Income from cattle, %	*	*	7	20
Facilities scale	2.5	4.9	3.2	3.9
Management and record scale	0.6	1.1	1.0	1.4
Health practices scale ^b	*	*	1.8	2.8
Marketing practices scale	0.2	0.6	0.3	0.6
Age of operator	59	55	*	*
Years of schooling	11.5	12.2	*	*
Total family income, thousands	14	26	*	*
Scale of spouse involvement	0.6	0.8	0.9	1.2
Scale of memberships	0.1	0.6	0.2	0.4
Scale of knowledge	*	*	2.3	3.9

^a Except where noted, data represent averages.

^b Each scale created by assigning a value of 1 to each item to which the producer responded positively. Number of items considered varied from scale to scale.

* Differences for these are not significant.

Table 1.7. Summary of significant differences in characteristics between producers who vaccinate voluntarily for brucellosis and all others in Oklahoma and Arkansas (derived from tables 1.5.1 and 1.5.2).

Producer characteristics ^a	Oklahoma		Arkansas	
	All others	Vacc. vol.	All others	Vacc. vol.
Herd size	95	44	*	*
Herd type, % improved	*	*	11	20
Income from cattle, %	20	12	*	*
Management and record scale	0.7	1.4	*	*
Health practices scale ^b	*	*	2.1	2.7
Marketing practices scale	0.4	0.7	*	*
Age of operator	60	53	*	*
Years raised cattle	32	21	*	*
Scale of spouse involvement	0.5	1.0	*	*
Scale of memberships	*	*	0.2	0.5

^a Except where noted, data represent averages.

* Differences for these are not significant.

In Oklahoma, those who do not vaccinate, when compared with those who do, have poorer facilities, lower levels on the management and record-keeping scale, less sophisticated marketing practices, a lower socioeconomic status (education and income levels both are lower), less involvement of the spouse in the livestock operation, and lower levels of membership and participation in organizations, and are older.

Arkansas nonvaccinators -- compared with vaccinators -- have smaller herds, less frequently have "improved" herds, receive a lower percentage of their total family income from their cattle operation, have poorer facilities, are lower on the scale of management and recordkeeping, use significantly fewer other recommended animal health practices, use less sophisticated marketing practices, and have lower levels of spouse involvement, participation in organizations, and knowledge about brucellosis.

Some of the data show very little difference between vaccinators and nonvaccinators, such as poultry production (which occurs primarily in

Arkansas), off-farm employment, percentage of income from "other" farm sources (presumably a rough indicator of commitment to farming in general), producer health problems, and agricultural background and training including 4-H membership. The frequency of poultry production and off-farm employment are both somewhat higher for those who do not vaccinate, suggesting a conflict of time and(or) commitment. But these differences are small. This, together with the lack of association of vaccination with the percentage of income from "other" farm sources, suggests that lack of commitment to farming -- not being "legitimate farmers" -- is not a major cause of nonvaccination.

In Arkansas those who do not vaccinate report producer health problems less frequently than do those who vaccinate. In Oklahoma, the difference between the two groups is extremely small. Overall, having had experience with vocational agriculture, FFA, or 4-H, and having studied agriculture in college, does not significantly increase the probability of vaccinating calves for brucellosis.

Producers Who Vaccinate Voluntarily

The first columns of tables 1.5.1 and 1.5.2 provide a summary of the characteristics of those who vaccinate but have had no experience with quarantine. Thus they represent the "best" in terms of compliance with the brucellosis program.

When it comes to characterizing those who vaccinate voluntarily, there appears to be a larger difference between the states. In Oklahoma (tables 1.5.1 and 1.7), those who vaccinate voluntarily, as compared with the combined average of the other two groups, have smaller herds, receive a lower percentage of their family income from cattle production, have higher scores on the management and recordkeeping scale, use more sophisticated marketing practices, are younger, have been in livestock production a shorter time, and, finally, have higher levels of spouse involvement in the livestock enterprise.

In Arkansas (tables 1.5.2 and 1.7) the statistically significant differences between those who vaccinate voluntarily and those who do not exist only for the health practices scale (higher) and membership and participation in organizations (higher).

In both states, those who vaccinate voluntarily are similar in some respects to those who do not vaccinate at all: both groups have somewhat smaller herds and depend less upon agriculture for their family income than do those who have been quarantined and now vaccinate. Given these similarities, their differences are primarily in management, animal health practices, facilities, and marketing strategies.

Producers with small herds tend to have inadequate penning and working facilities and to lack contact and experience with the brucellosis program. Obviously, they must be the major target of communication strategies, both because of their larger numbers and because of higher probability of their not vaccinating (table 1.4). It would appear that four things should be taken into consideration in targeting communication strategies at them:

1. There are many small-herd owners who comply, voluntarily and effectively, with the brucellosis program. Their motives, their methods, and their approaches could be helpful in developing communication strategies for other producers. A major problem may be that for small producers who have other significant sources of income, compliance may seem to be more trouble than it is worth. Thus, appeals will have to be made to a) altruism -- based, for example, upon the public health aspects of the disease, the impact upon the total industry, etc. or b) to a sense of "craftsmanship" in farming. Vaccination of calves would then be presented as the "right" thing for "good" producers.
2. The most consistent characteristic associated with noncompliance with the brucellosis program is the inadequacy of penning and work-

ing facilities. Cooperative methods of loaning portable penning and working facilities, or any other measures to reduce the inconvenience of vaccination, should be effective ways of increasing compliance.

3. Experience with quarantine seems to guarantee that producers will vaccinate. Although voluntary compliance is obviously preferable to a regulatory approach, more contact with "the program," and emphasis on the consequences of quarantine, especially in Arkansas, should increase compliance significantly.
4. A variety of management features are associated with nonvaccination. There are both good and poor managers among small-herd producers -- who constitute the great majority. Improving management in general, and animal health practices in particular, is an important objective for those working to help livestock producers. Unfortunately, it is not clear that higher levels of management are always economically rational for livestock producers, especially for those with limited time and limited dependence upon agriculture. The question of the role of management in relationship to brucellosis prevention requires further study. For example, we need to know which producers can actually benefit economically from vaccinating calves, and then other appeals need to be identified to influence those for whom it is not economically beneficial.

The picture that emerges is one of quite rational behavior on the part of livestock producers. Those who do not have adequate facilities, those who have not had previous experience with quarantine, those whose herds are relatively small and -- in this case -- contribute relatively little to the family income, and those whose marketing and management practices are casual are those who do not vaccinate. Many of these variables are interrelated, in the sense that when we control for facilities and(or) management practices, for example, the effect of herd size is reduced or removed entirely.

CHARACTERISTICS OF WELL-INFORMED PRODUCERS WHO DO NOT VACCINATE FOR BRUCELLOSIS

We identified a special group of producers: those who were well informed about brucellosis based upon the eight-question test used, but who still did not vaccinate. Understanding the characteristics of these producers might provide insight into possible rational reasons for not vaccinating (table 1.8).

Table 1.8. Summary of significant differences in characteristics between 1) producers who are well informed about brucellosis but do not vaccinate ("know, but do not") and 2) all others in Oklahoma and Arkansas.

Producer characteristics ^a	Oklahoma		Arkansas	
	Know, but do not vaccinate	All others	Know, but do not vaccinate	All others
Herd type, % "improved"	*	*	00	17
Raise poultry, %	*	*	58	27
Income from "other" farm sources, %	*	*	41	16
Facilities scale	2.5	3.7	3.3	3.6
Management and record scale	0.7	1.1	*	*
Health practices scale	*	*	1.9	2.4
Marketing practices scale	0.2	0.6	0.4-**	0.4+
Age of operator	58	56	48	55
Years raised cattle	25+**	25-	21	25
Years of schooling	*	*	13	11
Completed high school or college, %	50	60	*	*
Total family income, thousands	14	24	*	*
Scale of spouse involvement	0.6	0.8	0.9	1.1
Scale of memberships	0.1	0.5	*	*
Scale of agricultural training	0.6	0.8	1.8	0.8
Involvement with 4-H, %	17	26	*	*

^aExcept where noted, data represent averages.

*Differences for these are not significant.

**Although there are no differences here, when other variables are controlled, these are significantly different.

In Oklahoma, these well-informed producers who do not vaccinate are characterized by poor penning and working facilities, generally poor

management practices, are older, have been in cattle production somewhat longer, and have somewhat less income and education. Spouses are somewhat less likely to be involved with these operations, the producers are less involved in organizations and have lower levels of agricultural background and experience.

In Arkansas the patterns are different. None of the well-informed producers who do not vaccinate have improved herds, and a large portion raise poultry and receive a large amount of family income from farm sources other than cattle production. As in Oklahoma, their facilities and overall management practices are less than adequate. However, the producers are younger than those who vaccinate, and they have been in cattle production a shorter time. Finally, as in Oklahoma, spouses are less likely to be involved in the operations.

Thus, in the two states the characteristics differ for those who are well-informed but who do not vaccinate except that penning and working facilities are deficient in both states, general management appears to be lower, and spouses are less involved.

CHARACTERISTICS OF PRODUCERS WHO HAVE QUARANTINED OR INFECTED HERDS

In the survey we did not measure infection itself. Knowing that a producer's herd had been quarantined was taken to indicate that that herd was infected.

Using quarantine as a proxy measure for infection must be done carefully. Producers with larger herds market cattle more frequently. Some voluntarily have their cattle tested just to be able to market them. So their animals are more often tested for brucellosis than are animals from small herds. Thus, we controlled for herd size and type before using quarantine as an indirect measure of infection.

When data from the two states are combined, herd size and herd type influence the probability of being quarantined. Larger herds and improved herds are much more likely to have experienced quarantine, and those who have experienced quarantine are then more likely to use additional animal health practices.

The survey of producers who have had quarantined herds as compared with producers who have not showed the former receive a larger percentage of their income from outside sources, have lower levels of management and recordkeeping, are older and have raised cattle longer, are less likely to report health problems, and are better informed about brucellosis.

Because of their differences, it is also informative to look at the states separately. Table 1.9 presents a profile of quarantined and not-quarantined herd owners in both states.

Herd size and type of quarantined herds are important, but much more so in Arkansas than in Oklahoma. When controlling for the herd size and type, interesting patterns emerge. First, the percentage of family income that comes from other farm sources is important, but in opposite directions in the two states. In Oklahoma, those who are quarantined receive less income from other sources; in Arkansas, quarantined producers receive much more -- usually from poultry production. Ironically, though, poultry production is not associated with high knowledge or not vaccinating.

The scale of penning and working facilities also is important in the two states, but in opposite directions. In Oklahoma, those who are quarantined have poorer facilities than those not quarantined and are poorer managers. In Arkansas, they have better facilities, use better health practices, and have greater organization involvement.

Table 1.9. Summary of significant differences in characteristics between producers who are quarantined for brucellosis and those who are not in Oklahoma and Arkansas.

Producer characteristics ^a	Oklahoma		Arkansas	
	Not quar.	Quar.	Not quar.	Quar.
Herd size	56	123	49	93
Herd type, % "improved"	6	8	10	32
Raise poultry, %	5	4	*	*
Income from "other" farm sources, %	5	3	19	35
Facilities scale	3.6	3.1	3.4	4.5
Management and record scale	1.2	0.5	*	*
Health practices scale	*	*	2.1	2.9
Vaccinate now and past, %	20	8	14	18**
Age of operator	55	61	*	*
Years raised cattle	22	25	23	29
Some formal schooling	0.6	0.8	*	*
Producers with health problems	25	11	*	*
Scale of spouse involvement	0.9	0.3	*	*
Scale of memberships	*	*	0.2	0.6
Farm Bureau membership	13	4	*	*
Scale of brucellosis knowledge	*	*	2.7	5.1

^aExcept where noted, data represent averages.

*Differences for these are not significant.

**Here those who are quarantined are more likely to vaccinate than those who do not. However, when other variables are controlled, this reverses, with those who are quarantined being less likely to vaccinate than the others.

Finally, in Oklahoma spouses are less likely to be involved with operations that are quarantined. In Arkansas, those producers in quarantine are more involved in organizations and are better informed about brucellosis.

The Oklahoma pattern represents characteristics that are usually associated with brucellosis infection. Arkansas, on the other hand, presents some anomalies. Why, for example, would those who use higher levels of animal health practices, who are more involved in organizations, and who are much more informed about brucellosis be more likely

to have infected herds? This is not what one would expect. The probable answer is that quarantine experience has caused these differences rather than the differences having caused infection and therefore quarantine.

SOURCES OF INFORMATION ABOUT ANIMAL HEALTH

There are some differences between the two states in the sources of information used by livestock producers. Overall, farm magazines are the most frequently used sources in both states (50% in Oklahoma and 65% in Arkansas), followed by private veterinarians (37% and 44%) and, in Arkansas, the Cooperative Extension Service (42% compared with 11% in Oklahoma). Government veterinarians, radio and television, sale barn people, and farm suppliers, all of whom were included in the questionnaire, were not frequent sources of information about general animal health issues.

Producers were asked about their sources of information about brucellosis. Farm magazines were mentioned most frequently (39% of producers in both states). Private veterinarians, government veterinarians, and the Cooperative Extension Service were each cited as information sources by nearly 18% of the producers interviewed. The major state differences again concerned the Cooperative Extension Service, which was mentioned by 27% of the producers in Arkansas and by only 7% in Oklahoma.

Questions were also asked about specific publications that producers read and about whether or not they obtained brucellosis information. Table 1.10 ranks the magazines the producers read.

Given the frequency of magazine readership, and the extent to which producers identified farm magazines as sources of information -- even about brucellosis -- some of these magazines are obvious targets for

Table 1.10. Magazines most frequently read by producers.^a

Magazine	Oklahoma	Arkansas	Both states
<i>Progressive Farmer</i>	54	54	54
<i>Farmer-Stockman</i>	52	3	27
<i>Farm Journal</i>	20	22	21
<i>Farm Bureau Press</i>	3	33	18
Breed magazines	11	11	11
<i>Beef</i>	9	11	10
<i>Drover's</i>	6	7	6
<i>Successful Farming</i>	3	2	3
<i>Dairyman's Digest</i>		3	2

^a *Delta Farm Press*, *AMPI Magazine*, and *Hoards Dairyman* were each read by only one person in the survey.

innovative communication strategies. The *Progressive Farmer* is read by more than 50% of all producers, many of whom do not vaccinate.

Farm Bureau membership is also an important source of information in Arkansas. Messages from Farm Bureau can potentially reach a significant portion of the nonvaccinating livestock producers there.

PRODUCER EXPERIENCES, ATTITUDES, AND OPINIONS AS RELATED TO THE BRUCELLOSIS PROGRAM

A very high proportion of producers regard brucellosis as a serious problem (93% in Oklahoma and 91% in Arkansas). Eighty percent of those who said brucellosis was a serious problem said it causes producers to lose money. But in Arkansas, 3 out of the 5 producers said that brucellosis was not serious because it had no serious economic consequences for small producers.

Most producers felt that the rates of infection in the last 5 years have either remained the same or have declined. Only 31% in Arkansas and 6% in Oklahoma felt that infection rates had increased.

About 36% of the producers have been, or are presently, in quarantine. Eighty-nine percent of these felt at the time of quarantine that their options had been explained adequately by the officials responsible for the quarantine (slightly higher in Arkansas). Of the five in Oklahoma who said the options had not been explained adequately, three said they had received no explanation at all, and another said that no options were given. Quarantined producers said that the worst thing about quarantine is inconvenience (48%) and economic loss (37%). Inconvenience was more important in Arkansas, and economic loss in Oklahoma. Most producers said that the experience with quarantine had caused them to buy more cautiously and to begin vaccinating calves, which they had not done before.

The project also seeks to cooperate with organizations and agencies interested in brucellosis eradication by providing additional tabulations and analyses of special interest. For further information, contact Donald F. Voth, Department of Agricultural Economics and Rural Sociology, University of Arkansas, Fayetteville, AR 72701.